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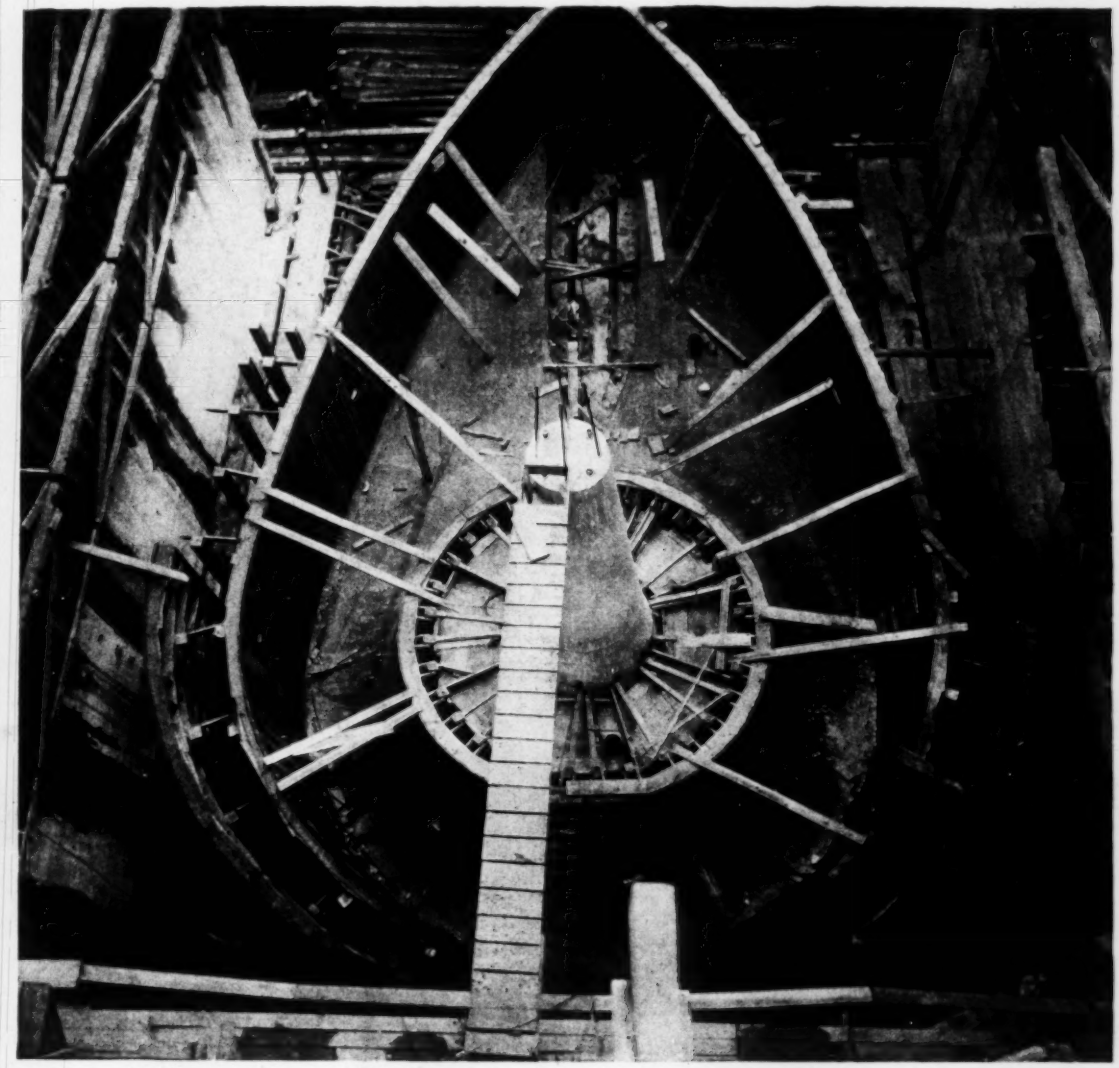
Engineering News-Record



Looking down into the draft tube of one of the turbines under construction at Muscle Shoals

Building Wilson Dam at Muscle Shoals—Part I

Trench Excavator Builds Road Grade Across Lake of Mud

Strengthening and Re-decking Old Bridge for Traffic

Reviews of Recent Books on Engineering Subjects

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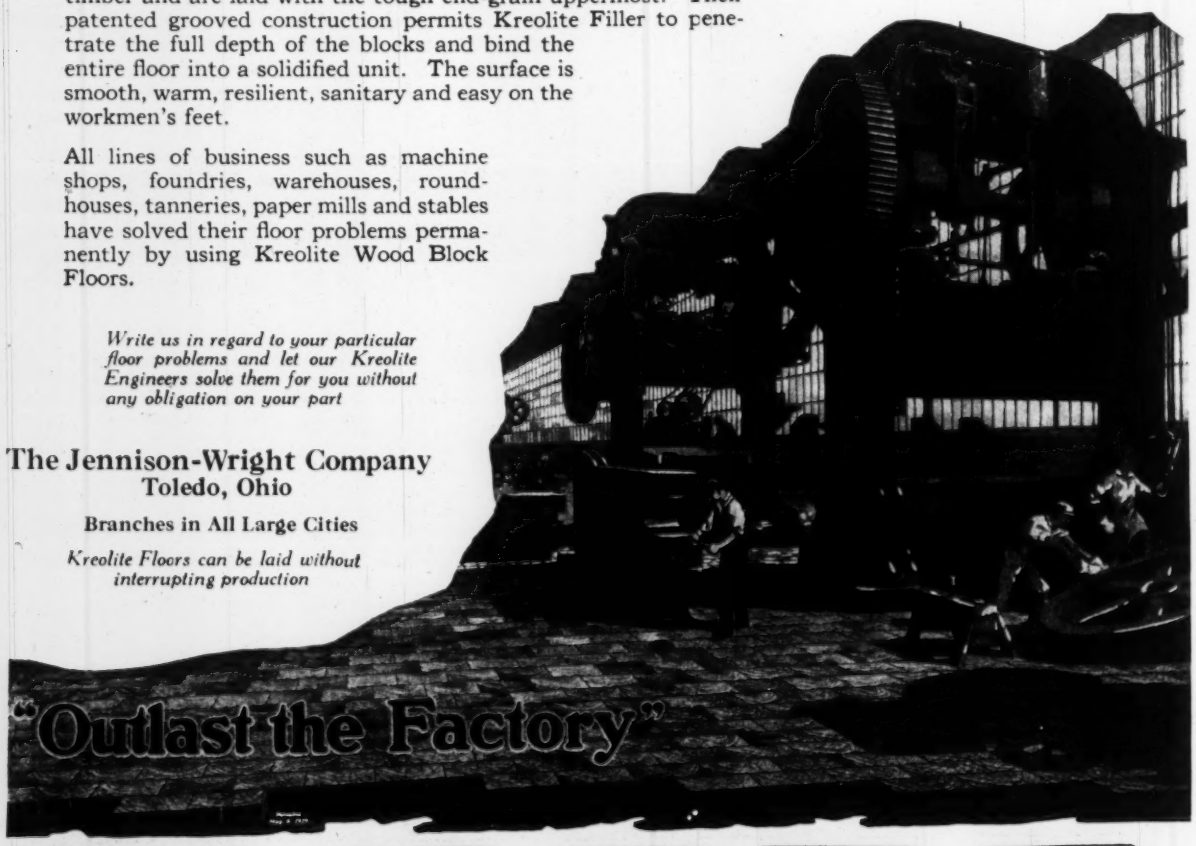

WOOD BLOCK FLOORS

A Consolidation of Engineering News, Engineering Record and The Contractor

ENGINEERING NEWS-RECORD

McGraw-Hill Company, Inc.
JAMES H. McGRAW, *President*
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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 94 NEW YORK, APRIL 23, 1925 Number 17

If It Would Only Rain

CHICAGO is a little out of luck in the behavior of the elements. Reports from the upper of the Great Lakes say that this is so far a record low water year, that "at Alpena the level is about five inches lower than it was a year ago for the same period" and the Lake Carriers Association (no doubt with a solicitous eye to the publicity for its fight against the Chicago diversion) is advising Duluth-Cleveland boats to load six inches lighter than last year. All of which is news not neglected by the anti-Chicago interests on both sides of the line. Regardless of the fact that the Chicago diversion can be responsible for no more than six inches lowering and that that half-foot must be deducted from what the Lakes were before the diversion was made and not from what they were last year, the cry has already gone up that Chicago is draining all the water down the Mississippi and the Lakes are gradually going dry. It is unfortunate for the Chicago claims that the crisis in her claims for the lake water should have been coincident with a general low water period. The whole city should set to and pray for rain in the north country, or else open negotiations with the California rain-maker who, according to the report of his success, is either a mighty good guesser or a wizard.

No Compulsory Arbitration

AFTER the latest decision of the United States Supreme Court, abstracted on p. 690 of this issue, there seems nothing to do but for the Kansas Court of Industrial Relations to go out of business. Two years ago the Supreme Court's first ruling merely delimited those businesses which might properly be said to be clothed with public interest, to the extent of saying that the packing business was not so clothed and therefore not subject to interference by the state in the matter of wages, hours of work or any other working conditions or arrangements. It did not define the powers of the court in those businesses properly said to be in the public interest. The latest decision, however, goes out of its way to denounce the whole theory of the court. Compulsory arbitration—a possibly contradictory term defended as to use by the Supreme Court itself—is unconstitutional when applied to contracts, made or implied, between capital and labor, whatever be the nature of the business in which they are engaged. In a way this decision was to have been foreseen. Freedom of contract and the inviolability of property are pretty thoroughly fixed by our law. But nevertheless the Kansas court was an honest effort to settle one of the sore spots in our industrialism, and its failure is, to that extent, deplorable. For what they were seeking in Kansas was some way in which to protect the public in the quarrels between capital and labor, some way other than the time-honored one of letting the two fight it out and the public be damned. But evidently Governor Allen and his advisers were ahead of their times—and of the Constitution—and the enforced appreciation of the public's interest in industrial disputes must be discarded. We must fall back on the growing tendency of both capital and labor to look to their advancement through the advancement of the whole army of industry, rather than to seek always that which for the time seems to be the selfish desideratum. Co-operation, not coercion, must be looked to for results.

City Streets Get Gas Tax

AN INNOVATION in the allotment of motor vehicle license and gasoline tax funds for road improvement is introduced by the highway law recently enacted in Wisconsin. Incidentally the law, summarized elsewhere in this issue, eliminates direct state taxes for highways. Motor vehicle imposts, with a gasoline tax, provide all state funds for road construction and upkeep. It is, however, the disposition of state funds for maintenance that distinguishes the new law. First, city or village streets on state or county systems receive the same maintenance allotment as any other road of the same classes. Second maintenance money is allotted to local roads and streets not on the state or county systems. For the last purpose: "There is set aside annually $25 per mile for town roads and village streets; $50 per mile for streets in cities up to 10,000 population; $100 per mile for streets in cities of 10,000 to 39,000 population; $150 per mile for streets in cities of 39,000 to 150,000 population; and $200 per mile for streets in cities of more than 150,000 population." This distribution of motor vehicle tax income for local road maintenance is, it is believed, unique. In a number of states the county roads share in the license fees and gas taxes but nowhere else does any of the funds get to the township road or the city street. Indeed the new law controverts completely the creed that practice has set up over the country that motor vehicle tax income is sanctified to the uses of the rural road and to the main state and county thoroughfare. Between this practice and that set up by the new Wisconsin law there is a wide gap. Without argument for either side it will be well for highway engineers to inquire whether the action of the Wisconsin legislature may not presage a shift of thought that will materially affect rural road development.

Wendover Cutoff

RARELY nowadays does road construction offer anything new and particularly distinctive. In general about the same equipment and processes in varying combinations are employed on all road construction. Serviceability of machines and finesse of process have improved, but nothing fundamentally different in equipment or method is used or practiced. So it comes that road construction affords constantly fewer and fewer examples not in large part merely repetitive. There-

fore, it is particularly notable when, as was the case in building the road across the Salt Lake desert in Utah as described in this issue, unusual machines and original methods are brought into use. The article leaves very little further to be said of the difficulties or of how they were overcome. Obviously the highway builders were fortunate in having a railway which was astonishingly friendly to a closely paralleling highway and also in the fact that the great organization operating the salt beds had developed a way of building embankment on the salt crust from the mud under the crust. Shrewdly combining the experience of the salt company's engineers with the services of the railway the road engineers performed a remarkable piece of construction under seemingly insuperable difficulties of ground. And soft ground was not the only trouble. There were intense cold and bitter winds and a skin searing alkali brine to make workmen's lives uncomfortable and to incapacitate work animals. Altogether no more unique operation of road building than the Wendover cut-off in Utah has been recorded.

Specifications for Society Papers?

CAN technical society meetings be kept more nearly to the ideal by the use of "specifications for speakers"? If specifications were printed in a standard form the speakers could hardly take any offense and it would certainly help the program committee or secretary in keeping meetings more nearly to the desired limits of time and subject matter.

Local sections of national engineering societies and the many branch or local technical organizations throughout the country are continually holding meetings to listen to papers. These are usually written expressly for the occasion, are not published later and frequently the authors are without experience in public speaking. This makes the problem of specifying the qualities of the ideal paper for the "local" society somewhat different from that of the society that prints papers in full to make them available for reference, and it is to the branch or local society problem that the following comment is directed. However, even where the paper is to be published later and may therefore contain tabulations and detailed figures generally, there are certain requirements that must be observed if it is to be presented orally to best advantage.

After selecting a suitable subject and finding a speaker who is able to handle it, those in charge of the program committee have still an important duty to the society before complete arrangements for the paper of the evening may be said to have been made. Speakers often need to be reminded of those essentials to a successful presentation which they are wont to overlook—an oversight which is a disadvantage to speaker and meeting alike. For example, the speaker must remember that the average listener does not possess an indelible memory and that a rapid reading of figures leaves him no wiser than before. A good paper will not be cluttered up with detailed figures or other non-essentials. Some general figures are usually necessary, of course, and unit costs are often very desirable, but the value to the hearer lies in what he can carry away from the meeting room in notes or memory, chiefly the latter.

Another important thing for both author and committee to remember is the complications that arise when an oral abstract of a too-lengthy paper is attempted. Too frequently do speakers take more time in an impromptu abstract than would have been taken by a full reading of the paper—with an accompanying confusion of the thought both given and received. If such an abstract is deemed necessary by the society representative, the author should take as much pains in preparing the abstract as he did in preparing the paper.

Taking these things into account, therefore, the program committee should try to see (1) that the author makes his paper truly informative, (2) that he presents it in an attractive manner and (3) that he omits all non-essentials and keeps the time of presentation strictly within the prescribed limits. In the case of subjects of a controversial nature or even where there is room for differences of opinion the possibility that each writer will have bias, pet theories and a limited viewpoint should be recognized, so the program committee might well insist that an outline be submitted in advance so it may be passed along to those likely to entertain different opinions.

The man who is to present a paper must be persuaded to consider the viewpoint of his hearers and ask himself what he would want if he were the average listener; he should read his paper aloud before delivering it and time himself; he should welcome any suggestions or instructions from the program committee as helps in making for the best success of the meeting; finally, he should be most careful not to commit the unforgivable discourtesy of exceeding the time limit assigned him.

Some such specifications carefully considered and faithfully followed will make the presentation of a technical paper less of an ordeal for all concerned than it too frequently turns out to be.

Permanent Roadbeds for Railways

SPEAKING before the American Railway Engineering Association at its convention in Chicago a few weeks ago, Frank H. Alfred, president of the Pere Marquette Railway, took the railway engineers to task for following rather than leading in the matter of railway research. He held up the automobile manufacturers, the oil industry and the great electrical companies as examples of the advantages to be gained from expending large sums of money in research work. As a specific example of the kind of research needed on the railroads, Mr. Alfred took the design of a permanent roadbed, declaring that if a satisfactory type could be developed the saving in track labor, in wear and tear on track and rolling equipment as well as the advantages of better riding track, would offset the expenditure of large sums for the permanent roadbed. He suggested the construction of a number of test sections of such roadbeds and their study by the American Railway Engineering Association.

Few railroad engineers will question the desirability of such an investigation as Mr. Alfred proposes, even though they may take exception to his charge that they lag behind in the development of new materials and devices. They all know how unstable a structure is the average railroad roadbed in this country, especially under the greater loads and greater concentration of loads in the present day. To meet this condition, sub-ballast has been introduced to distribute the pressure over the roadbed, ballast has been used at greater and greater depth below the ties, ties have been in-

creased in size and number, and weights of rail have been increased at frequent intervals during the last few years, while at the same time much attention has been given to the improvement of rail joints. But notwithstanding the heavier rail, greater tie bearing, and deeper ballast, track on the average roadbed still gets out of line and surface and railroad engineers riding over the smooth track on ballast-deck bridges are bound to wonder whether some such roadbed cannot be made for more important railroad lines.

Mr. Alfred takes the transition from dirt and gravel roads to concrete highways as an indication of what may be expected in railroad work, pointing out that when first proposed many people felt that the benefit to be derived from concrete highways would not warrant the expenditure, and yet now most of the important highways are built of concrete because it was found that gravel roads would not stand up under dense automobile traffic. There is a joker in this analogy as far as the railroads are concerned. The highways are being built with public funds raised by bond issues paid for out of taxes and not out of income derived from the traffic on the highways. Doubtless, the railroad companies would be willing to undertake the construction of their lines on a concrete base if the country would stand for a sufficient increase in rates to carry the investment.

Similarly, a lack of funds is the basis for the railroads' backwardness in the matter of research. Their case is not comparable to the automobile manufacturers or oil companies, for these companies are not held by government regulation in narrow way bounded on one side by regulated rates and on the other by restricted profits. And they can spend money on research and development without having its legality questioned by a government bureau.

That the railroads have already made some experiments in the design of permanent roadbeds is shown in the columns of *Engineering News-Record* and in the 1920 report of the Ballast Committee of the A.R.E.A. in which several types of such track structures were illustrated. The experiments date back to 1908 and 1909 when the Michigan Central and the Lackawanna built concrete roadbeds in the Detroit and Bergen Hill tunnels and the New York Central built a long concrete slab over soft clay at Poughkeepsie, N. Y., and laid four tracks on rock ballast on top of the slab. These experiments were followed in 1914 by a still more extensive one on open track with medium traffic on the Northern Pacific where about 2,000 ft. of unballasted track was laid with different types of concrete roadbed. Although this track is still in service, the cost of maintenance has been higher than for adjoining ordinary track. The most recent use of concrete roadbed is in the approach tracks of the new Union Station at Chicago, where a slab has been laid under the stone ballast in order to keep it from being pounded into the soft ground along the Chicago River.

However, these scattered experiments will be of little value unless they are followed up by further experiments based upon the experience already gained. Surely, some of the railroads whose finances are now back to something like normal can be prevailed upon to make such experiments in view of the importance of the subject and the possible economy to be gained from some form of permanent roadbed.

Meanwhile, an up-to-date report on existing installations by the Roadway Committee of the American Railway Engineering Association will be of value.

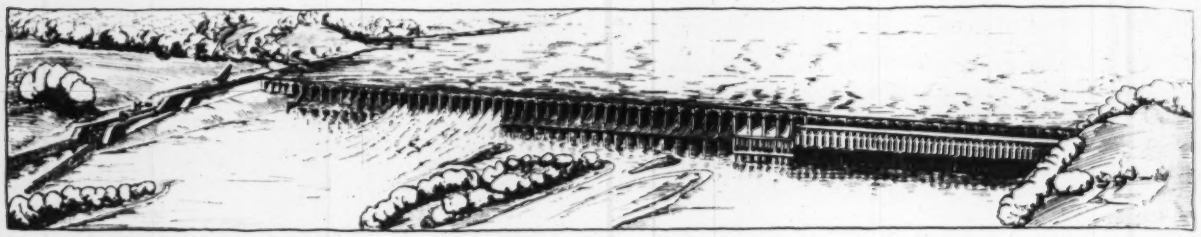
Expensive But Good

AN ACCOUNT of the Wilson Dam as a construction operation begins in this issue. More generally known as the Muscle Shoals hydro-electric development, this project has in recent years been actively discussed in all its elements except engineering design and construction. So, with the article in this issue and one to follow, the neglected feature of construction is given its meed of notice in the scheme of a development which has exercised the politicians of half a dozen Congresses. It is not possible to tell all the construction story. The operations have been too large and too long continued to permit full presentation. Only certain outstanding elements of construction plan and methods are considered. These however are of a high degree of interest to constructors.

Of first importance is the fact that the construction of the dam and power plant is virtually force-account work performed under unusual conditions of supervision. While the army engineers are doing the work with hired forces and with government funds they are doing it according to the plans and specifications and subject to supervision as to performance and quality of a private firm of consulting engineers. In other words, the Corps of Engineers is contractor on this work, but a contractor with no restriction as to cost or profit.

It would be idle to say that this is the best way to carry on public work, for its deficiencies are obvious. But it is right and fair to say that it has resulted in an admirable piece of construction. Every engineer and contractor who visits Muscle Shoals comes away with the belief that it is one of the finest pieces of massive concrete work ever built. Whether or not the project could have been built cheaper by contract, or by the usual force account method in which the engineers and the constructors are identical, is a fair question. Certain it is that the frequent change of engineer officers, from the chief in charge on the job down through the peripatetic lieutenants, must have been costly in more ways than one. And a contracting organization, long trained in such extensive operations, should have been able to plan and plant the work more economically than a succession of army officers unaccustomed to work on any such scale.

But these things cannot be proved, because there are no comparable facts, and until there are comparable facts—and a thorough examination of the whole expenditure at Muscle Shoals—critics of the way the dam and power house were built should be careful not to generalize. The whole Muscle Shoals adventure cannot be measured by ordinary standards; procedure in its development grew by what it fed on and changed from day to day and month to month out of all semblance to itself at the start. It is easy now to criticize the way things were done in the light of what has been done, but when one undertakes to do so one should read the history of the project and not stand on some academic hill and view the situation as an abstract problem. The Wilson Dam undoubtedly cost a lot of money, probably much too much money, but it is a remarkably fine piece of masonry.



Building Wilson Dam at Muscle Shoals on the Tennessee—I

How Work Was Planned, Construction Camp Located, Excavation and Sub-Foundation Exploration Carried Out and Concrete Placed on the Largest Dam in this Country

The description of the work will be given in four sections under the headings: (1) Construction Plan and Work Quantities; (2) Foundation Exploration and Excavation; (3) Concreting Plant and Procedure; and (4) Electrical Equipment of Construction Plant. The first two sections are given below; the other two sections will appear in an ensuing article.—EDITOR.

WILSON DAM is the official designation of the group of structures for the much-proclaimed hydro-electric development at the Muscle Shoals of the Tennessee River in Alabama. In volume it is the largest concrete dam in the world; it will cost over $50,000,000 and it will develop 612,000 hp.

As shown by the pen sketch, the dam proper begins on the north shore of the river at the lock which will pass navigation. The total length of structures is about 4,900 ft., of which the dam is 3,098 ft. This length comprises 200 ft. of north-abutment section, 2,668 ft. of spillway section, and 230 ft. of sluiceway section. The power house, forming part of the river barrier, is 1,250 ft., the lock and abutment 150 and the switch-house building 400 ft. The north abutment is the usual gravity section, with battered face and vertical back, and its flat crest is at El. 506. Superimposed piers and arches form a bridge which joins the movable span across the lock.

The face of the spillway section is of ogee form, its back is vertical and its crest is at El. 483. This section likewise has piers, which support arches and thus form a continuation of the high-level bridge. The piers are 8 ft. thick and the clear spaces between them are 38 ft. long. There are fifty-eight of these 38-ft. openings, and each has a discharge capacity of 11,800 sec.-ft. when pool surface is at El. 501. Each 38-ft. opening is fitted with a steel gate 18 ft. high, which has a vertical movement on roller trains.

The sluiceway section is of gravity type with a flat crest at El. 506, and is also surmounted by the piers and arches of the bridge. It contains thirteen sluices 9 ft. in diameter and a trash chute 23½ ft. wide.

The normal width of the dam proper at the base may be taken as 160 ft. Because, however, of periodical floods discharged over a structure 98 ft. above the bed of the river, it has been necessary to equip the dam with wide downstream aprons to prevent the scouring of the rock below it.

The over-all length of the power house and forebay structure is about 1,250 ft. and its width is 160 ft.; from top of power house to foundation rock is about 150 ft. The forebay structure contains the control gate system, the screens and the 54 concrete conduits through which the water is conducted to 18 hydraulic turbines. Surmounting it is the concrete bridge connecting the bridge on the main dam with the south shore roadway system.

In the substructure are the scroll cases, which receive the water delivered by the conduits and distribute it uniformly around the periphery of the Francis turbine runners. The water is discharged to the river below the power house through concrete draft tubes.

The superstructure is 75 ft. wide and 65 ft. high.

The dam contains an inspection gallery at El. 411 which is about 9 ft. above the original rock surface of the river. This gallery is 6x9 ft. Its use is threefold: First, the relief pipes which extend downward into the rock beneath the dam to relieve any water that would tend to exert an upward pressure on the dam are directly underneath, and extend upward into the inspection gallery where they make a right-angle turn downstream and discharge into the spillway. The amount of water that is relieved by these pipes is ascertained by means of gages situated in the gallery. Second, the three-way valves and discharge pipes for the regulating gate displacement tanks are also situated in this gallery. Third, it provides for the accumulation and discharge by pumping of the usual leakage through the dam.

The power generating machinery now in process of installation consists of four main units of 30,000 hp. and four main units of 36,200 hp. each and one house service unit of 1,000 hp. The power generated will be produced by one runner to each unit mounted on a vertical shaft.

Direct-connected to the main shaft is the generator. The first four generators will have a capacity of about 25,000 kva. and the remaining fourteen generators will have a capacity of 32,500 kva.; both capacities at 80% power factor. The current generated will be 3 phase, 60 cycles, at 12,000 volts.

The design and construction of the dam were carried out under the direction of the Chief of Engineers, U.S.A. This office was held by Gen. Lansing H. Beach to June 15, 1924, when he was succeeded by Gen. Harry Taylor, now in office. All construction has been by day labor under the immediate direction of army engineers

who have been in charge in following order: Col. Hugh L. Cooper, April 1 to May 24, 1918; Maj. D. A. Watt, to May 1, 1919; Col. J. B. Cavanaugh, to July 12, 1919; Liet. Col. Lytle Brown to Sept. 20, 1920; Col. W. J. Barden, to May 15, 1923, and Lieut. Col. G. R. Spalding to date. These officers have reported directly to the Chief of Engineers. On May 19, 1920, the Chief of Engineers made a contract under the terms of which Hugh L. Cooper & Co. have since that time been designing and supervising engineers.

Engineering and general expenses as of Sept. 1, 1924, had been: Engineering and superintendence, $712,976; clerical, $662,777; office, $171,773; holidays, $542,015; garage, $345,399; recruiting and discharging labor, $232,485; and flood losses $50,000. These amounts do not include the designing and supervising engineers' fees and expenses.

1. Construction Plan and Work Quantities

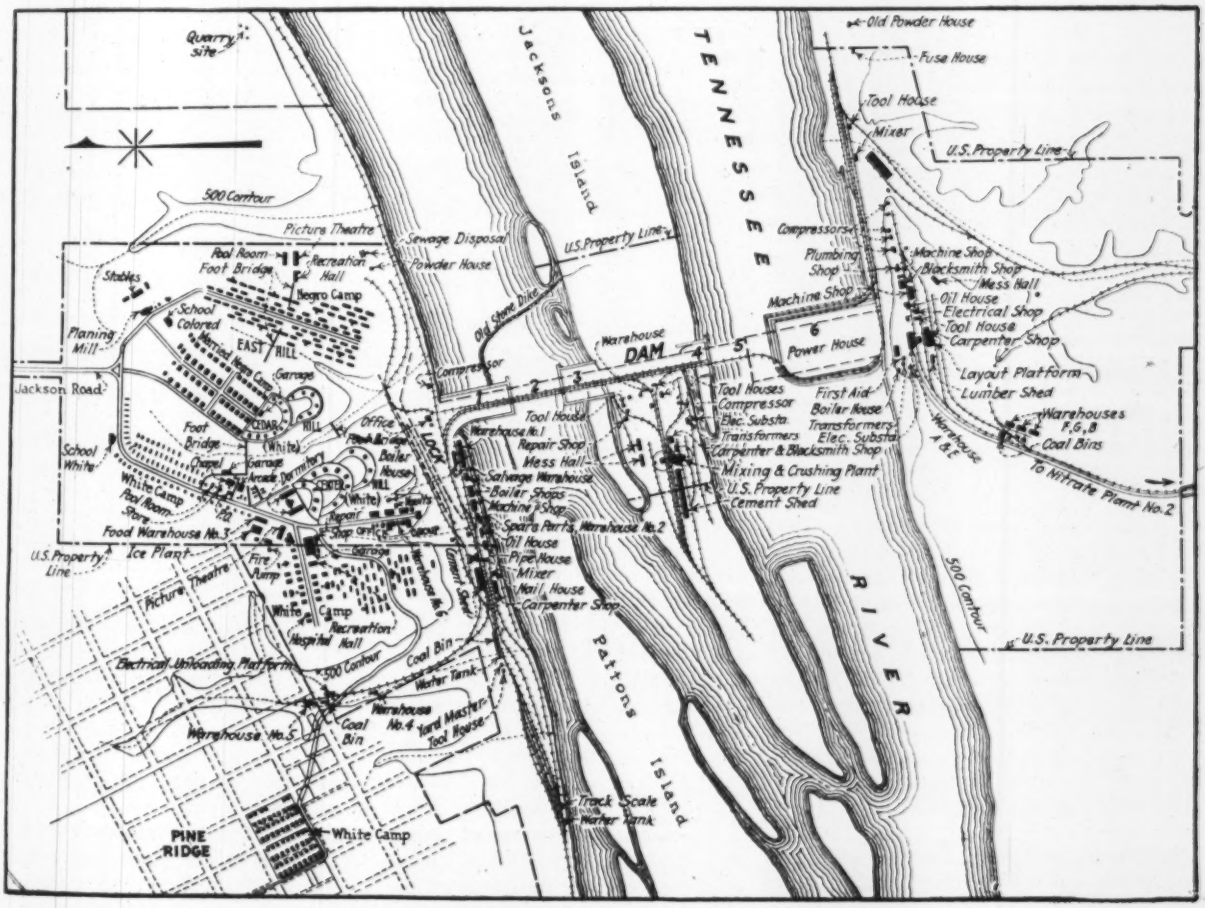
Developing Access and Site—Transport and Distribution—General Plant Plan and Directing Organization

Construction operations on the Wilson Dam have presented a variety of remarkable features. The structure had a volume of concrete work exceeding that of any other dam in the world. It had to be built on a rock bed requiring careful exploration and preparation, across a stream having quick and high-flood rises. It was constructed by day labor. There were long shutdowns and many changes of managing direction. The structure was complex in parts and a high quality of workmanship and materials was required.

The main structures have been described. In them all, there were some 1,400,000 cu.yd. of concrete, 700,000 cu.yd. of rock excavation, and 350,000 cu.yd. of earth excavation. Of these volumes, about 1,234,000 cu.yd. of concrete and 452,000 cu.yd. of excavation were in the main dam structure. In addition, temporary structures included some 6,500 ft. of cofferdam, 27½ miles of railway, 600 camp and service buildings, 7½ miles of roads and 5 miles of sewers. These figures indicate the large construction volumes in which excavation and concrete construction were the preponderating items.

Conditions of Site and Access—A rock reef across the river between Brown's Island and Florence, Alabama, forms the Muscle Shoals. At the site of the dam, 2½ miles upstream from Florence, the ledge is substantially flat and clean, and the river is divided into two channels by Jackson's Island. On the north shore the nearest railway, at Florence, is 2½ miles away. The nearest railway on the south shore is 3 miles away. The only roads approaching the dam site were indifferent and the routes were hilly. Florence, having a population of perhaps 11,000, could not care for an influx of 3,000 to 5,000 workmen and their only way of getting to work would be by the river or by highway, if they lived at Florence.

Down to the site of the dam the river slopes about



CAMP AND CONSTRUCTION PLANT LAYOUT MAP OF WILSON DAM

Three-group plant arrangement with interconnecting railway system and outside railway connection on each shore gave direct railway service from every producing unit of plant to every consuming unit of structure.

100 ft. in 15 miles. Here, we note again, it is divided into two channels by Jackson's Island, low and flat, about 900 ft. wide and 2 miles long. The river banks are steep bluffs close to the full channel and about 4,300 ft. apart. At low water in summer the average minimum flow is about 12,000 sec.-ft. In the highest flood recorded, the flow was 450,000 sec.-ft. With an unobstructed river this flow gives a flood rise of 33 ft. The ordinary spring floods give a rise of about 20 ft. The velocity then is about 4 ft. a second.

Considering these conditions of site and access and the volume of structures previously given, the dominant requirements were: A camp community for a protracted housing of workmen and conduct of work; a system of transport to bring in and distribute construction equipment and materials, and a construction plan which would handle flood discharges and normal river flow as well as enable quick and economic fabrication of structures.

Camp Provisions—A plateau on the north bluff, whence road and rail connections to Florence were easiest, was the logical camp site. Here some 550 buildings were constructed for residence and administration and for community services. At the foot of the bluff, on Jackson's Island and on the south shore some 50 other buildings, mostly plant structures, but a few for local mess and office use, were built. This second group is indicated by the plant map. The 600 buildings formed virtually a small industrial town with water supply, sewerage, electric service, postal service, club house, theater, stores, etc. Both site and buildings were unusually attractive and being under the direction of army engineers the camp housekeeping and sanitation were of an excellence of which few permanent communities can boast. From 2,500 to 3,000 persons were housed in camp. Camps had cost to Sept. 1, 1924, $1,155,509 for construction, $338,153 for maintenance and $1,164,628 for operation or a total of $2,658,290.

Transport and Distribution—Except some rock from excavation, which could be crushed on the site for concrete aggregate, and some plum stones from a nearby quarry, all construction materials, equipment and supplies had to be brought in from the outside. Railway connection was essential. This was provided by a branch from the Southern Ry. to yard and distribution tracks on the south bluff top and by a similar branch from Florence along the foot of the north bluff to yard and distribution tracks on the north shore. A distribution and service track system on Jackson's Island and across the river joined together the two branch line systems. All these railway lines are shown on the plant map. They aggregate about 28 miles of standard-gage track.

In getting in sand and gravel for concrete—this was the largest volume movement—the railway branch on the north shore was fed by a barge line between Florence and Buck Island. Two hydraulic dredges at the island pumped to two screening plants and these delivered to barges which were towed to a gantry-crane unloading plant at Florence. The cranes unloaded to bins which loaded trains of 20-cu.yd. cars and a 60-ton locomotive which delivered at the Jackson's Island mixing plant or to one of the supplemental mixing plants as shown on the plant map. The maximum output at Buck Island was 100,000 cu.yd. in the month of May, 1924. Delivery, naturally, was mostly at Jackson's Island where the main mixing plant was and where a stock varying from 50,000 to 150,000 cu.yd. was stored.

It is important to note of the railway transport system as described, that it provided not only for bringing in material to the fabricating plants and storage places but also for distribution from mixing plants, form yards, etc., to the dam structures where the cranes did the final placing. Substantially there was standard-gage railway service from the outside directly to every fabricating and construction unit of the operation. This was a fundamental element of the construction plant: To connect up by the job transport service every producing unit of plant with every consuming unit of structure.

The railway structure was 80-lb. rail on cross-ties

UNWATERED SECTION OF RIVER BED AT DAM SITE

The rock bottom was found to be flat and clean except for surface layers torn up by current. Vertical seams divide the rock into 30 to 35-ft. squares. Crib cofferdam appears in background.

TABLE I—WORK QUANTITIES WITH TOTAL COSTS AS OF JAN. 1, 1925

(These figures should not be used for computing unit costs)

Item	Unit of Measure	Quantities: Work Done to Date	Quantities: Estimated Total Official	To Date: Field Cost	To Date: Prorata Overhead	To Date: Total Cost	Unit Cost to Date	Per Cent Complete	Remarks
LOCK SECTION									
1. Cofferdams	1 cu.yd.	37,566	15,000	$38,633	$18,078	$56,711	$1 51	62 3	Est. quantity revised to 54,535
2. Earth excavation	1 cu.yd.	360,600	355,851	190,985	89,371	280,356	0 78	78 7	Est. quantity revised to 457,911
3. Rock excavation	1 cu.yd.	161,715	230,300	539,799	252,598	792,397	4 90	80 5	Est. quantity revised to 200,926
4. Preparing foundations and grouting	Lump sum			7,325	3,428	10,753		81 4	
5. Concrete	1 cu.yd.	61,104	76,600	639,081	299,060	938,141	15 35	73 2	Est. quantity revised to 83,438
6. Gates, valves, etc.									
a. Gates and operating machinery	Tons		910	10,622	3,314	13,936		5 0	
b. Valves and operating machinery	Tons		65	19,447	6,067	25,514		52 9	
7. Backfilling	1 cu.yd.	2,582	25,000	1,592	745	2,337	0 91	10 3	
8. Riprap	1 cu.yd.	59,720	1,800	23,780	11,128	34,908	0 58	42 7	
9. Bascule bridge	Tons		340	9	4	13			
10. Operating house and lock accessories	Lump sum			10,039	4,698	14,737		11 0	
11. Highway (approach to lock)	Lump sum			2,780	1,301	4,081		7 0	
12. Lighting and signals	Lump sum			5,049	2,363	7,412		27 3	
13. Grading and planting	Lump sum			5,058	2,367	7,425		14 5	
14. Reinforcing steel	Tons	117 21		6,326	2,960	9,286	79 23	92 8	Est. quantity revised to 126 25
Total lock section				1,500,525	697,482	2,198,007			
SPILLWAY SECTION									
1. Cofferdams	1 lin.ft.	6,997	6,997	1,190,324	557,012	1,747,336	249 73	99 8	
2. Construction bridge	1 lin.ft.	4,380		860,053	402,463	1,262,516	288 25	82 7	Est. quantity revised to 4,380
3. Earth excavation	1 cu.yd.	185,644	185,644	164,470	76,964	241,434	1 30	100 0	
4. Rock excavation	1 cu.yd.	143,495	145,000	863,876	404,251	1,268,127	8 84	100 0	Est. quantity revised to 143,495
5. Preparing foundations and grouting	Lump sum			147,490	69,018	216,508		*92 6	
6. Concrete									
a. Dam, piers, sluiceway and north abut.	1 cu.yd.	626,909	650,000	5,669,004	2,652,814	8,321,818	13 27	99 1	Est. quantity revised to 632,316
b. Bridge	1 cu.yd.	37,153	30,000	653,587	305,847	959,434	25 82	90 1	Est. quantity revised to 41,245
c. Reinforced (sluiceway)	1 cu.yd.	4,138	6,100	70,941	33,197	104,138	25 17	93 2	Est. quantity revised to 4,438
d. Reinforcing steel (sluiceway)	Tons	40 9	26	2,681	1,255	3,936	96 23	100 0	Est. quantity revised to 40 9
7. Spillway gates and misc. machinery									
a. Gates				15,401	4,805	20,206		5 5	
b. Roller train									
c. Masonry castings	Tons		7,500	264,515	82,520	347,035		77 7	
d. Operating machinery				62,001	19,366	81,367		16 0	
e. Wells and castings				264,242	82,411	346,653		*78 9	
f. Cranes and crane track	Lump sum			12,041	3,757	15,798		16 4	
g. Sluiceway pipe and castings	Lump sum			320,175	99,884	420,059		*92 2	
8. Paving sluiceway apron	1 sq.ft.	11,250	12,000	19,697	9,217	28,914	2 57	100 0	
9. Spillway division wall	Lump sum			59,128	27,668	86,796		89 3	
10. Highway									
a. Surfacing tracks and parapet	Lump sum			1,978	925	2,903		1 7	
b. Lighting and accessories	Lump sum			4,705	2,201	6,906		15 6	
11. Cleaning up	Lump sum			11,104	5,196	16,300		14 8	
12. Conc. for protection below apron, N. end	Lump sum			283,990	132,893	416,883		89 0	Does not include Section "C"
13. Extra work				34,148	15,980	50,128			
Total spillway section				10,975,551	4,989,644	15,965,195			
POWERHOUSE SECTION									
18 unit installation									
1. Cofferdams	1 lin.ft.	3,430	3,530	586,443	274,427	860,870	250 98	86 3	
2. Earth excavation	1 cu.yd.	15,710	55,710	8,047	3,766	11,813	0 75	100 0	
3. Rock excavation	1 cu.yd.	293,615	307,369	1,154,398	540,201	1,694,599	5 77	94 9	
4. Preparing foundations and grouting	Lump sum			38,259	17,903	56,162		100 0	
5. Forebays and substructure									
a. Mass concrete	1 cu.yd.	296,140	350,000	2,791,284	1,306,185	4,097,469	13 84	98 0	Est. quantity revised to 302,091
b. Mass reinforced concrete	1 cu.yd.	133,788	150,000	1,931,124	903,671	2,834,795	21 19	99 5	Est. quantity revised to 134,466
c. Reinforced concrete	1 cu.yd.	3,119	11,500	93,572	43,787	137,359	44 04	52 2	Est. quantity revised to 5,974
d. Reinforcing steel	Tons	1,559 72	2,500	86,290	40,379	126,669	81 21	92 0	Est. quantity revised to 1,696
e. Miscellaneous (conduits, etc.)	Lump sum			48,750	22,812	71,562		100 0	
6. Buildings									
a. Powerhouse superstructure	Lump sum			934,816	437,448	1,372,264		67 8	
b. Switchhouse and switch yard	Lump sum			363,986	170,328	534,314		*46 7	Cubic contents 1,549,700 cu ft.
c. Machine shop and equipment	Lump sum								
d. Generator lead tower and elev.	Lump sum			87,075	40,747	127,822		*46 6	Cubic contents 216,200 cu ft.
e. North elev. tower and equip.	Lump sum								
7. Equipment									
a. Racks and stoplogs	Tons		1,665	69,526	21,689	91,215		*68 8	
b. Penstock gates	Tons		2,200	105,236	32,830	138,066		50 7	
c. Hydraulic machinery	Units		18	576,058	91,673	667,731		51 0	
d. House generators	Units		1	27,391	2,455	29,846		81 2	
e. Electric machinery	Units		18	800,535	124,871	925,406		47 6	
f. Switching equip. and conductors	Lump sum			38,886	12,131	51,017		3 3	
g. Cranes and mechanical equip.	Lump sum			64,934	20,257	85,191		61 1	
h. Mechanical filters and piping	Lump sum			14,572	4,546	19,118		*25 2	
i. Ice and trash fenders	Lump sum								
8. Highway									
a. Surfacing tracks and parapet	Lump sum			1,727	808	2,535		3 4	
b. Lighting and accessories	Lump sum			1,795	840	2,635		13 8	
9. Powerhouse railway	Lump sum			90,004	42,117	132,121		*94 0	
10. Cutoff wall, south shore	Lump sum			320,335	149,901	470,236		100 0	
11. Grounds and roads	Lump sum			14,782	6,917	21,699		22 8	
12. Retaining wall and bridge, S. shore	Lump sum			218,337	102,172	320,509		77 4	
13. Cleaning up	Lump sum			5,078	2,377	7,455		10 2	
14. Retaining wall, N. and S. end P. H.	1 cu.yd.	6,572	5,900	59,412	27,802	87,214	13 27	100 0	
15. Concrete weir and equipment	Lump sum								
16. Extra work				27,206	12,732	39,938			
Total powerhouse section				10,559,858	4,457,772	15,017,630			
LAND									
1. Sites	1 acre	570 6	570 6	75,997	35,562	111,559	195 51	91 5	
2. Overflowed land	1 acre	7,054 5	7,212 4	412,355	192,962	605,317	85 81	97 8	
3. Road changes									
4. Railroad right-of-way									Included in sites
5. Clearing reservoir	1 acre	7,777	3,340	638,108	298,604	936,712	120 45	100 0	45,051 chargeable to "To Date Cost Only" Est. quantity revised to 7,777
Total land				$1,126,460	$527,128	$1,653,588			
Total cost of work items						34,834,420			
Undistributed overhead						1,698,112			
Net total						36,532,532			

*Per cent complete revised.

Note—The method which was used to obtain total cost of work items as given on this sheet was to divide them into three groups: the heavy machinery, the light machinery and the construction (excavation, concrete, etc.) groups the heavy machinery receiving only ½ and the light machinery ⅛ of the proportion of overhead allotted to the construction items.

kept well surfaced on a good roadbed. As of Sept. 1, 1924, there had been constructed 28.8 miles of railway at a total cost of $852,549 or about $29,600 a mile. To that date there had been spent $412,694 for maintenance and $505,910 for operation. About the only special structure was the bridge across the river which was a stout viaduct of plate girders on concrete piers capable of standing up against flood. It provided four tracks over the north channel and three tracks over the south channel. The main equipment units were 26 locomotives, 79 box cars, 65 flat cars, 60 dump cars (20-cu.yd.), 15 gondola cars and 24 locomotive cranes. This was all regulation standard-gage equipment.

Construction Plan—Excavation and concrete are the main construction volumes. Planning naturally involved plant and methods for excavation and for concrete construction. These are described under separate headings. Equally important in planning, however, was the necessity of scheduling excavation and concrete work so as to handle normal flow and periodical high water or floods. This required closing the channels a part at a time, using cofferdams. These cofferdams are indicated by the plant map. Interruptions by war and delayed appropriations disorganized the schedule somewhat, but in general the plan was to build in cofferdams 1, 3, 4 and 6; then tear them out and build in 2 and later 5. In dams 4, 5 and 6, across Jackson's Island, and on the north shore, the work was carried up solid. In dams 1, 2 and 3 only the footing was completed and on it the piers, stiffened by a bit of rollway section as described elsewhere, were erected, leaving 29 openings to pass the flow. Later these openings were filled as is described elsewhere. This whole plan of handling floods worked out without serious drawback, although dam 1 was flooded three times, and Jackson's Island and dam 6 were both under water twice.

General Plant—The splitting of the wide channel by Jackson's Island was of decided assistance in planning the plant layout. With this site available for the main crushing and mixing plants the job haulage of concrete was about halved and all hauling distances were cut down. A three-group layout, as shown by the plant map, was adopted, a plant group on each shore and one on Jackson's Island. The complete interconnection of these groups by railway has already been observed.

Concrete production plant was bulked on Jackson's Island. As stated, this split the hauling distance for most of the concrete and permitted the installation of quantity production units. To get away from the hazard of having "all the eggs in one basket," however, and more because they would facilitate local operations, supplementary mixing plants were installed in both shore groups. In case of break-down on Jackson's Island these shore plants were in position to substitute. Their big value, however, was that they took care of special operations at both lock and power house ends and left the main plant free to swing into a steady stride on the main dam concreting. Some service buildings were put into the Jackson's Island group but virtually this group of structures was a concrete production unit.

Form production, the second big task in concreting, was split between the shore groups. The logic of this arrangement was that it cut down carriage of forms and lumber and that it separated the quite different form building for lock and main dam from that for the power house with its complex penstock, draft tube and scroll case construction.

The equipment items of the several principal plant operations are mentioned in connection with the work they did. As of Sept. 1, 1924, purchase and construction of plant had cost $4,469,014. About $270,000 had been spent to that date in maintenance and $1,048,474 for operation.

Progress and Work Quantities—Construction was begun in the spring of 1918, but was so interrupted by suspensions by the War Industries Board that it was a year later before real progress was made. Then progress was good until April, 1921, when work had again to shut down because of lack of appropriations. Money being provided, work was resumed in June, 1922, and was continuous thereafter. On Jan. 1, 1925, the work quantities, the work done, and its cost were as given in Table I. This table is chiefly interesting for the insight which it gives of the number and variety of work items. Later tables give unit costs.

2. Foundation Exploration and Excavation

Rock Under Dam Core-Drilled and Grouted and Abutment Ledges Were Tunneled and Filled With Concrete

Certification of the foundations for the Wilson Dam received special attention commensurate with the importance of the structure and also because in the Muscle Shoals reaches of the Tennessee River the rock formation is fissured and frequently cavernous. Solidity and tightness were therefore foundation qualities to be ascertained with particular care. They were requirements not only for the ledge under the dam but also for that in the ridges forming the end abutments. It followed that in providing the dam foundations exploration, concluded by consolidation where the rock was found fissured, was the first construction task. The second task was excavation approximating half a million cubic yards and, therefore, a major operation of drilling, blasting and hauling. This classification of operations is retained in the account which follows.

The rock at Muscle Shoals has been classified as "Lauderdale chert with inclusions of limestone and black flint." It is in horizontal layers from 2 ft. to 5 ft. thick with a dip of 3 to 5 deg. to the southwest, and is traversed by seams two ways which cut the strata into squares about 30 to 35 ft. on each side. The line of the dam cuts across these seams at about a 45-deg. angle. They vary in thickness up to 2 or 3 in., and are filled with mud down for 8 or 10 ft., and below this with calcite, very brittle and easily shattered by blasting. The view, p. 678, shows the rock surface as laid dry by the cofferdams; it is covered with water-loosened stones of the upper stratum.

Foundation Bed—Considering first the foundation for the dam; the excavation section for the spillway portion, 2,900 ft. long, is shown by the section. Under the power house portion 1,250 ft. long, there is, besides the deeper heel trench, a corresponding trench under the turbines. The width of foundation excavation under both spillway and power house may be taken as substantially 160 ft. While there was, in places, extension of the apron width, the excavation required was

hardly more than a surface cut. Testing of rock solidity, then, was confined to a strip about 160 ft. wide across the river. It consisted of well-drilling holes, putting on air pressure to determine leakage and, if leakage was disclosed, of forcing grout into the hole.

Drilling began in the lock at the north end and was continued the full length of the dam and power house. In the heel trench of the spillway portion there were two lines of holes. The first-line holes, about mid-width of the trench, were nominally 20 ft. apart, but the distance varied, the purpose being to get one hole and sometimes two holes in each block of the dam, these blocks being 36 ft., 48 ft. and 54 ft. long. These holes were 56 ft. deep. Staggered with the first-line holes there was a second row just inside the upstream face of the dam; these holes ranged from 25 ft. to 40 ft. deep. In the trench, then, there were always three test holes and sometimes there were four, for each block of the dam. Under the rollway base one line of holes 15 to 20 ft. apart and 20 ft. deep was located near the heel trench and another line of holes 20 to 40 ft. apart and 40 ft. deep was located near the toe. These two lines gave three or four test holes per block of dam. In the power house heel trench there was one line of 30- and 40-ft. holes spaced 20 ft. apart or nominally three holes to a block.

When drilled, a pipe with an expanding plug was inserted and air pressure put on. For the first test the pipe was inserted 1 ft.; it was then shoved down a few feet and pressure again applied. This procedure was repeated as many times as was necessary fully to explore the hole and locate any leak. The air pressure employed was 1 lb. per foot depth of test which was somewhat less than the weight of rock above. The number of tests depended upon the conditions disclosed. If the air held the pressure for five minutes it was considered that there was no leak. The leaks generally were vertical joints. All were grouted at 30-lb. pressure and the borehole then filled with grout. Comparatively few holes showed leaks and generally one-half to one bag of cement was enough to grout a hole. A few holes required five or six bags of cement. An exact drilling, testing and grouting record was kept of every hole.

Prior to the tests described, during the survey of the site in 1915, two lines across the river, of diamond drill holes, were put down. The two lines were 115 ft. apart and the holes in each were 100 ft. apart. They were 40 and 75 ft. deep but five were 100 ft. and four were 200 ft. deep. These holes showed good rock, a negligible loss of air and some cavities. On their showing the bedrock was held to be adequately solid and tight for a dam foundation and the later borings supported the conclusion.

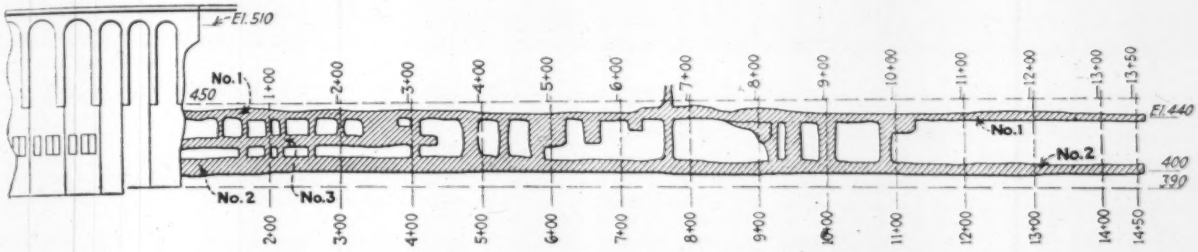
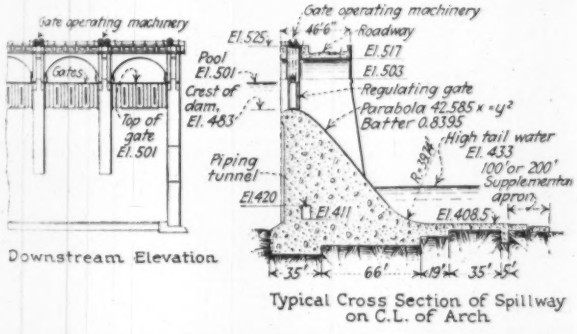


DIAGRAM OF EXPLORATION DRIFTS INTO SOUTH ABUTMENT LEDGE

These drifts and connecting rises explored the rock for 1,500 ft. into the south bluff; they were virtually a major rock tunneling operation.



SPILLWAY CROSS-SECTION AT CROWN OF ROADWAY ARCH

This construction applies exactly only to the spillway section. The sluiceway section and the power house section, however, give about the same base width and depth of foundation excavation.

Abutment Ledges—High and steep bluffs are the shores of the river. These are of the same rock as the river bed. On the north side the bluff top reaches back as constantly high land for a considerable distance. It was felt that there was not much chance that water would in any amount encircle the north dam end and exploration was limited to drifting into the ridge about 135 ft. with a tunnel 3 ft. high and 9 ft. wide. The rock was found virtually solid; so the tunnel was filled with concrete and the dam end (lock wall) well keyed into the abutment ledge.

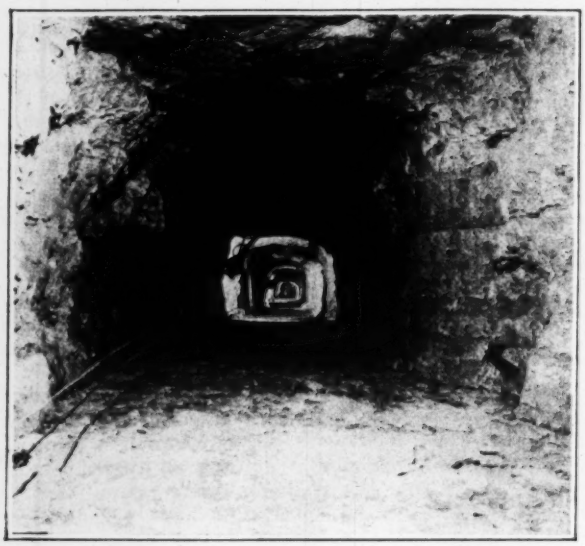
On the south shore the conditions were different. Here the ridge was comparatively narrow and behind it was a swale. Also on this side there were more indications (a test pit had been dug in 1919) of uncertain ledge conditions. A full exploration was held necessary. This consisted of drifting on a bent course some 1,500 ft. into the ridge to intercept any faults, fissures and cavities the ledge might have. The sketch shows the extent of the drifting and rising operations. Two views show the excavation. One is a view looking into the upper drift or tunnel and the other is a view of one of the particularly large "chert" seams which were encountered, cleared out and then filled with concrete.

Two tunnels, one above the other as shown, were driven into the ridge. The top drift was 6x6 ft. and the bottom was 6x8 ft. in section. In about 160 ft., a middle drift was begun between the other two and carried about 200 ft. Between drifts, rises were opened generally where a chert seam or pocket intercepted the drifts. These seams and pockets were encountered for about 900 ft. into the ridge and then decreased to only

occasional seams as disclosed by borings. Essentially one purpose of the drifts was to enable exploration of the interior of the ridge by core drill holes. All along the drifts to a distance of about 950 ft. diamond drill holes were driven diagonally up and forward from the roof of drift 1 and similarly down and forward from the floor of drift 2. At the ends of the drifts fans of holes 40 to 100 ft. deep searched the ledge ahead. Whenever met, the chert seams and pockets were cleaned out and filled with concrete by pneumatic placing. The tunnels were filled by the same method. Virtually a concrete corewall was inserted in the south bluff ledge to cut off possible seepage through the ridge and around the end of the dam.

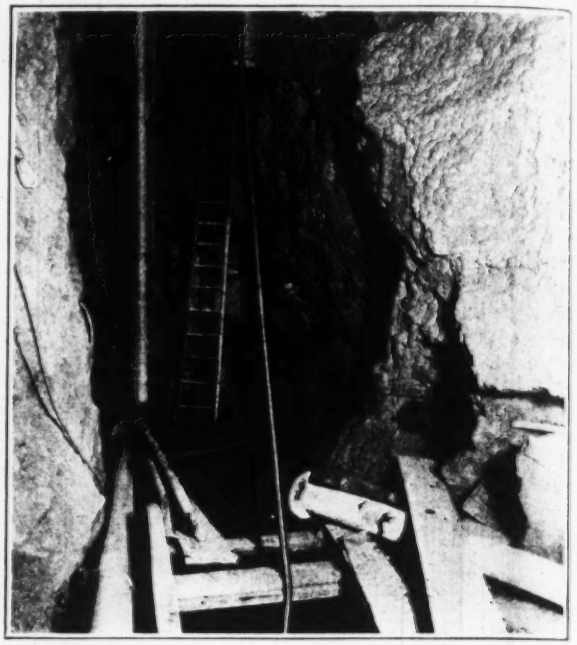
The sufficiency of the operations described to ensure solidity and tightness of the foundations and abutment ledges is a design question to be considered in another place. As a construction task the operations required some 35,000 ft. of core drilling and the placing of some 13,000 cu.yd. of concrete in tunnel and largely by blowing; and, beside these, extensive tunnel driving operations.

Excavation—For excavation, the river bed was laid dry by cofferdams as outlined in the preceding general plan of construction. As stated, the river bed was clean rock. There were about 452,000 cu.yd. in the dam foundation trench and over 230,000 cu.yd. in the lock emplacement. This material was handled by steam shovels and cranes into dump cars and hauled away. In general the blasting and handling required only ordinary processes. Drilling was the only operation which received particular technical study.



VIEW ALONG UPPER DRIFT EXPLORING SOUTH BLUFF
This drift was about 8 ft. square and from its roof diamond drill holes were sent searching into the rock for cavities. Floor of bottom drift was similarly drilled.

Drilling and Drill Tests—Besides the drilling for excavation there were many feet of hole required for dowel pins, anchor pins and other purposes all exclusive of the test drilling with core drills. As an example over 35,000 ft. of holes 26 ft. deep were put down in the rock below the dam for apron anchor rods of 1¼-in. twisted steel grouted in. Also there was considerable drilling of concrete. Various changes were made in drills and practice as tests and experience developed.



CHERT CHAMBER FOUND IN DRIFTING SOUTH BLUFF
These chert chambers and seams were all excavated and then, like the drifts, were filled with concrete placed by pneumatic process.

Until June, 1923, from the start in the fall of 1918, all drilling, except in the tunnel work, was done with 3½x6-in. piston drills using solid steel. The regular four-point bits, with double taper, were used. The hole was started $2\frac{3}{8}$ in. and reduced ¼ in. every 2 ft. Careful watching of gage was required to avoid binding. In June, 1923, a demonstration of hammer type drills was carried out for ten days. It resulted in the purchase of 18 of the largest type hammer drills. These were tripod machines. They weighed 207 lb. The piston weighed 13 lb., and had a diameter of 3 in. and a stroke of 4 in. The steels were standard 1¼-in. with a ¾-in. hole, and weighed 3.9 lb. per foot.

Comparison in practice of the piston and hammer drills showed considerably less air to be required by the hammer drills. While the piston drills were considerably worn by long use none was permitted in operation whose consumption exceeded 200 cu.ft. per minute of 100-lb. air. The hammer drills consumed 180 cu.ft. a minute. However, the hammer drills gave about 150 per cent more footage. The piston drills averaged 35 ft. of hole in 8 hours and the hammer drills averaged 80 ft. in ten hours.

In the tunnel work for exploring the abutment ledges, four hammer drills were installed in 1921 as wet drills.

Drilling was made difficult by the seams in the riverbed rock. They were often, toward the top, water bearing and filled with sand and gravel. Depth of hole was determined largely by the thickness of the strata as it was necessary to break the rock out on horizontal seams. The depth of excavation was about 16 ft. in the heel trench and 10 ft. under the rest of the base area. In general it was the purpose to get down below all mud seams to solid rock. This was done. No loose rock or even rock in which the brittle calcite seams had been shattered, was allowed to remain on the foundation bed, and the bed rock was meticulously cleaned before concrete was deposited.

In general the blasted rock was loaded directly into dump cars by steam shovel. Portions selected for crushing for concrete aggregate were hauled to the Jackson's Island crushing plant. The other parts were wasted. Up to Sept. 1, 1924, excavation had cost per cubic yard $3.14 in the lock, $6.02 in the spillway foundations and $4.09 in the power house. As shown by Table I in the preceding section, the preparation of foundation and grouting cost about $236,000.

Report Favors Proposed Ship Canal for Sacramento

Four Alternate Plans for Deep Waterway from San Francisco Bay—Costs to Range from $14,000,000 to $20,000,000

IN a report on the proposed Sacramento deep water canal, made March 3 to the Sacramento Deep Water Commission, C. E. Grunsky, consulting engineer, who was retained to make an economic survey of the project, expressed the opinion that the construction of a ship canal would be of general benefit to the entire central valley of California and of particular benefit to the nineteen counties in and adjacent to the Sacramento Valley. The area to be benefited by the canal to an extent which would warrant inclusion in a port district comprises all of Sacramento and Sutter Counties, the greater part of Colusa and Yolo Counties, and portions of Placer, Yuba and Solano Counties.

From the viewpoint of a comparison of revenue and operating expenses the construction of the canal would not be justified, it was pointed out, if it were to be undertaken by private capital as a commercial enterprise, but the direct and indirect benefits to the region in fair proximity to the canal and port would warrant carrying out the project by a port district.

Proposed Canal Route—Mr. Grunsky endorsed the canal route selected and surveyed by the late Major Paul M. Norboe in 1922 when he was assistant state engineer. This route, beginning in the channel of the San Joaquin River opposite the mouth of Seven-Mile Slough off the south shore of Andrus Island, would run north almost in a straight line until about opposite the city of Walnut Grove where it would curve and practically parallel the Sacramento Southern R.R. through Bloom's, Fay's and Beach Lakes and the basin of Morrison Creek, and cross the Sacramento city boundary 600 ft. west of the Freeport Road.

If the terminus were placed at the outskirts of the city, this course would be 32 miles long. Much of it is now in connecting sloughs needing straightening and deepening, the remainder is through silt-covered or mucky ground without rocky formation, so the cost of construction would not be excessive.

The report recommended that the canal be constructed so as to accommodate the large ocean-going vessels; and that construction might be progressive, beginning with a canal 26 ft. deep and 100 ft. wide at bottom, with a view toward an ultimate depth of 30 ft. and width of 160 ft. The harbor outlined would measure approximately 1,000 ft. in width by 2,050 ft. in length, the development to include 2,600 ft. of wharfage, a grain elevator, two 2-story transit sheds, a small-ship fueling station, paved roads and highways and a belt line railroad. The last is emphasized as absolutely necessary to the success of the port.

The harbor site recommended would contain 410 acres, and if not located directly at Sacramento should be situated about six miles south of the city in the Beach Lake district. The port district, the report states, should own all the land along the canal to a width of at least 500 ft. on each side. A connection with Sacramento River by canal and lock to accommodate river traffic and to freshen the water in the ship canal would be necessary. This connection canal would be 12 ft. deep, 250 ft. wide, and 1,200 ft. long, if the harbor is located at the city boundary.

Two Proposals—The alternate proposals for the canal construction, as submitted, with estimated costs, follow:

SITE A—HARBOR AT CITY		
Canal Size	100 x 26	160 x 30
Canal Cost	$10,141,045	$13,180,150
Harbor Cost	6,425,625	6,537,935
Railroad	816,500	816,500
Total	$17,383,170	$20,534,585
SITE B—HARBOR 6 MILES BELOW CITY		
Canal Size	100 x 26	160 x 30
Canal Cost	$7,737,107	$9,275,348
Harbor Cost	5,443,986	5,535,192
Railroad	1,141,950	1,141,950
Total	$14,323,005	$15,953,490

The annual expenses of the 26x100-ft. canal with harbor at the city, including interest on the investment at 5 per cent, are estimated at $1,496,500. For the 30x160-ft. canal the corresponding figure would be $1,690,300. The revenue under the assumption of successful operation of marine terminal facilities equal to or better than those provided at other terminals is approximated at $455,000 per annum at the opening of the canal in 1930—the earliest date it could be put in operation if it were stated at once. This would be expected to increase to about $950,000 by 1940, and to $1,660,000 in 1950.

Freight originating in the Sacramento Valley and adjacent territory that could be handled through a Sacramento port amounts to 450,000 tons annually, while the amount which could reach this area better through a Sacramento port than any other water terminal is about 125,000 tons annually, according to the report.

Mr. Grunsky warned the commission that the city of Sacramento must face the fact that the city of Stockton is planning the deepening and widening of its channel, that governmental assistance in that project has been recommended by U. S. Army engineers *(Engineering News-Record*, Feb. 26, p. 372); and that such channel improvement would make Stockton a competing port "to which a favorable differential in freight rate would draw shipments south of the Mokelumne River."

In order to make it possible to begin the canal at once, the chairman of the commission appointed from its members a committee vested with power to prepare the legislation necessary for the formation of a port district and have it introduced at the present session of the legislature.

Depreciation on Concrete Building

In a decision in the case of the C. R. McCauley Co. (No. 342, Docket No. 12, submitted Feb. 17, 1925, decided April 6, 1925), the United States Board of Tax Appeals ruled that on a reinforced-concrete building in good condition an allowance for depreciation at the rate of 2 per cent per annum is reasonable. The building in question is a four-story and basement reinforced-concrete building, 100x100 ft., erected in Brooklyn, N. Y., in 1905-6, at a cost of $150,000.

Lime Hypochlorite Lowers Psychoda Flies at Sewage-Works

Studies Made at Schenectady Indicate That 200 p.p.m. Will Reduce Flies 70 Per Cent and Not Upset Biological Action

By Morris M. Cohn
Superintendent, Bureau of Sewage Disposal, Schenectady, N. Y.

AN ATTEMPT made during the summer of 1924 to control the growth of the small gray moth fly, psychoda, in and around the trickling filters at the sewage-works of Schenectady, N. Y., proved conclusively that hypochlorite of lime can be used with distinct success for this purpose. The tests were of short duration and no claims are made for their thoroughness, but the results were clear-cut. A definite unit of measure was obtained for the decrease in fly life produced; chemical analyses were made that showed the effect of the treatment on the biological life in the stone beds and careful visual inspection was made of the filter area before and after the lime was applied. Even this limited investigation should, therefore, add to the meager fund of knowledge concerning the application of this extermination method on a working installation.

The Schenectady sewage-works consists of a stationary bar rack with 1½-in. openings in the clear, nine Imhoff tanks, three dosing tanks, six trickling filter beds of ½ acre each and the necessary sludge-drying beds. The effluent from the tanks enters the three dosing chambers equipped with 30-in. siphons that distribute the sewage over the filter stone by means of 1,287 round nozzles. The three dosing tanks have capacities of approximately 5,700 gal. each between the low and discharge levels and each tank delivers the tank effluent to just one acre of filter area. The normal dosing cycle is approximately five minutes, of which three minutes is consumed in filling and two minutes in discharging the dose. The flow being treated by the plant features on the days of the test averaged 9.5 m.g.d., which gave a filter loading of roughly 3.2 m.g.d. per acre of area.

Prevalence of Psychoda—Psychoda flies have always been in evidence about and to the lee of the filter area at Schenectady but never in such a great degree as has been reported from other trickling filter plants of the country. The flies have always imposed great hardships on those men delegated to the maintenance of the beds but never until the summer of 1923 did their influence reach beyond the plant site. During the latter period, strong north winds, coming at a time when the flies were thickest, blew great swarms to habitations over 1,000 ft. distant, greatly inconveniencing the residents. No formal complaint was lodged against the city but it was realized that a repetition of these conditions might lead to such action. No convenient provision being had at Schenectady to flood the filter area, it was decided to try bleach to exterminate the flies in 1924.

Psychoda eggs were present on the stone during the entire winter prior to the test and the grown flies made their appearance early in the warm season. By the middle of June, the psychoda had increased in numbers to such an extent that some remedial measure was necessary, and the chemical was then applied. Three solutions were prepared, each containing 20 lb. of hypochlorite of lime to approximately 40 gal. of water, and allowed to clarify by standing. On June 16, the solutions were decanted into the three dosing tanks during one discharge of the siphons and the chlorinated sewage was distributed over the stone surface. On the following day, the same procedure was carried out, using solutions containing 30 lb. of the chemical, and on June 18 the doses were increased in strength to 40 lb. of bleach. The lime used was the commercial brand and no attempt was made to determine the available chlorine contained in the solutions. On the basis of a hypochlorite of lime of 24.8 per cent available chlorine content and a resultant solution of some 5,700 gal., the computed strengths applied amounted to 104 p.p.m., 156 p.p.m., 208 p.p.m. on the three successive days. The advantage in varying the strengths in this manner was that it gave the writer opportunity to observe the action of the different concentrations on the fly life and on the gelatinous growth of the stone surface. It was feared that the sudden application of an excessive dose would affect the proper nitrification of the filters.

Measuring Fly Decrease—A novel method of actually measuring the decrease in fly life was suggested by E. S. Chase of Metcalf & Eddy, Boston, consulting engineers for the plant since 1916. Just before the first application of the bleach, standard pieces of fly paper were exposed 4 ft. above the ground, opposite the four sides of the filter area, for a length of time that included a complete dosing cycle of all the siphons. The same procedure was followed just after the last dose of chemical was applied. The number of flies caught on the papers on both occasions were counted and from these figures it was computed that a decrease in fly life that approximated 70 per cent had been effected. The writer's personal observation seemed to bear out the conclusion drawn from this measurement method. It was fortunate that the weather conditions were exactly similar at the time of both exposures, so no discrepancies were introduced. The flies gradually increased in numbers but they did not approach a nuisance again during the summer, and for this reason the experiment was not repeated. It was evident that 70 per cent of the existing grown flies were killed by the chlorine and that

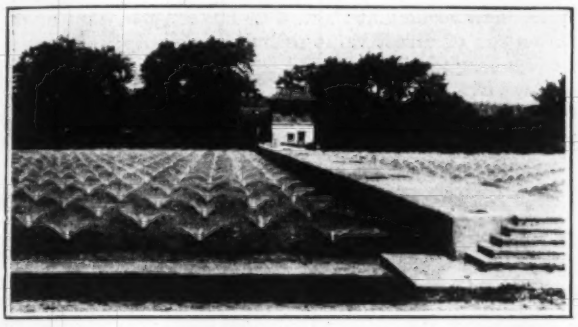
STUDIES OF EFFECT OF HYPOCHLORITE ON TRICKLING FILTERS OF SCHENECTADY SEWAGE-WORKS
(Parts per Million)

1924, Week Ending	Nitrogen as Albuminoid Ammonia: Total	Dissolved	Suspended	Free Ammonia	Nitrites	Nitrates	Date†	Oxygen Dissolved: Quantity	Temp., Deg. F.	Saturation, Per Cent	Stability Days	Chlorine	Residue on Evaporation: Total	Dissolved	Suspended	Loss on Ignition: Total	Dissolved	Suspended	Fixed Residue: Total	Dissolved	Suspended
June 7	3.00	0.78	2.22	4.5	1.600	4.900	June 6	3.7	59.0	36.4	9.0	44.2	416	370	46	142	102	40	274	268	6
June 14	3.00	0.73	2.27	4.3	0.700	6.050	June 13	3.8	61.0	38.6	8.4	45.5	432	378	54	158	122	36	274	256	18
June 21*	3.00	0.70	2.30	3.0	1.200	6.300	June 20	3.9	62.0	40.0	10.7	46.2	422	366	56	166	116	50	256	250	6
June 28	3.00	0.75	2.25	3.0	0.825	5.675	June 27	3.4	62.0	34.9	14.0	46.0	422	391	31	160	140	20	262	251	11

† 10 A.M. in each case. * Hypochlorite of lime tests made June 16, 17 and 18.

a great number of the larvae were also destroyed. The eggs were not rendered sterile and the gradual increase in flies can be attributed to the hatching out of these eggs. In view of the results obtained last year, preparations are being made to continue this study in the warm months to come. It is planned to apply a solution containing about 150 p.p.m. to each acre of filter area once every ten days so as to effect continual control of the number of grown flies that develop during the natural time-cycle of the fly life.

Observations made of the stone surface before and after the treatment showed that the lime had removed much of the grease that had coated the nozzle spindles



SEWAGE SPRINKLING FILTERS, SCHENECTADY

and some of the gelatinous film from the stone surface. The decrease in grease was not noticeable until after the second application. Just previous to the first dose of the chemical, the beds were experiencing some slight pooling which disappeared during the three day interval. Since the beds were picked over during this time, it is difficult to say which of the two causes led to the improvement. There is reason to believe that the removal of some of the gelatinous film from the stone must have aided in clearing up the beds. The removal of the grease improved the distribution from the nozzles.

Biological Action Not Upset—It has been understood that the greatest drawback to the use of chlorine for fly extermination was the danger of upsetting the biological action of the filters. There was no such upset at Schenectady. Analyses made on the effluent from the filters showed conclusively that there was no reduction in the quantity of oxidized nitrogen, dissolved oxygen or removal of free and albuminoid ammonias experienced in the week the chemical was applied. The accompanying table shows the analyses of the effluent from two of the filter beds for the weeks prior to, including and just after the treatment. Although the slight daily changes produced by the chemical might have been ironed out in the composite for the entire week, it is safe to say that, had any permanent harm been done, the analyses would have indicated it. It can be conclusively said that doses of hypochlorite of lime up to about 200 p.p.m. when applied to a healthy filter will not disturb its proper functioning.

Experience on Tannery Waste Filters—In marked contrast to the positive results in controlling the psychoda with relatively weak solutions of available chlorine, as obtained at Schenectady, are the results of similar tests run by Metcalf & Eddy on a demonstration trickling filter installed at the tannery of Winslow Bros. & Smith, in Norwood, Mass., as reported Sept. 25, 1914. At this installation, chloride of lime was applied to the filter area by means of a dosing tank, in strengths varying from 25 to 300 p.p.m., over a period of more than a month, using three consecutive doses per day. The flies were not reduced in numbers and the filter action was not affected. At a later date, a solution containing about 1,000 p.p.m. of available chlorine was used which reduced the total oxidized nitrogen in the final effluent but did not diminish the fly life. The dose was then increased to 1,600 p.p.m. and the flies practically disappeared. Determinations of nitrates and stability showed that the efficiency of the filter had been materially reduced. At this installation, Metcalf & Eddy finally decided that the larvae of the flies could be destroyed with a lower strength solution than the flies themselves and a solution containing 1,000 p.p.m. of chlorine, applied every two weeks, was suggested.

It is possible that the strong tannery wastes that were being treated by the plant in question introduced other factors than were present at Schenectady. It is certainly evident that a great portion of the available chlorine was used up by this strong liquid and by the gelatinous coating on the filter surface at the tannery plant. The great difference in results obtained in the two tests described proves that each case requires individual study to ascertain the quantity of chlorine that will destroy the psychoda without reducing filter efficiency.

Safe Water Signs on Highways at Entrance to Minnesota Municipalities

SIGNS indicating that the public water supply of a town about to be entered by a tourist or other traveler is safe are to be erected on highways at the instance of the Minnesota State Board of Health. On state trunk highways the signs will be placed for the board by the State Highway Commission and on other roads by the county highway engineers. The board feels that these signs will be appreciated by the public and by the cities and towns whose water supplies are thus certified and will stimulate backward municipalities to try to merit the placing of the signs at their gates. Conditions that must be complied with to get and keep the safe water signs have been thus summarized by H. A. Whittaker, director, Division of Sanitation, Minnesota Board of Health:

SAFE WATER SIGNS ON MINNESOTA HIGHWAYS
Original about 18x24 in. Lettering deep blue on white background. Attached below highway sign bearing name of municipality.

Municipalities which are permitted to post these signs agree to have the water supplies investigated at least once each year and to make any reasonable changes, alterations, improvements, or repairs to the water-supply system which may be necessary from time to time in order to maintain it in a satisfactory and approved condition, and to advice the State Board of Health in advance when any changes in the system are contemplated and to notify immediately the State Board of Health in case of any accident to the system which might impair the sanitary quality of the water. These municipalities further agree to make no objection to the removal of these highway signs in case the water supply is at any time found to be in a condition which would be considered unsatisfactory from a sanitary point of view by the State Board of Health.

Trench Excavators Build Road Grade Across Lake of Mud

Saturated Alkali Mud Flats, Divided by an Island of Salt, Are Traversed by New Wendover Cutoff Road West From Salt Lake City to Nevada State Line

A LAKE of soft clay carrying, like an ice floe, on one part, a crust of salt, and, over all, a sheet of water swept back and forth by changing winds, was the foundation of 41 miles of highway completed last year in Utah. The road is a path across a mud puddle. From the mud of the puddle itself trench excavators threw up an embankment on the mud and this embankment, graded flat, was surfaced with gravel. Now it is a firm road carrying traffic—the much talked-of Wendover cutoff—and it bids fair to continue stable and useful. It furnished the most novel example of road building methods of any highway constructed in 1924.

General Conditions—The map explains the route and purpose sufficiently. That portion of about 40 miles crossing the alkali mud flats and salt crust is all that called for unusual methods. This mud flat and the salt crust require description. They are the sediment of a geological lake. The mud flat is about 80 miles long and half as wide. In this flat, as shown by Fig. 1, is the island of salt, about 6½ miles wide where the road crosses. The salt crust varies from a few inches thick at the edges to 4 ft. thick in the middle. In the summer, or the dry season, the water table over a large area is about at mud surface level. In winter this area is covered with water up to a foot or so in depth varying with the precipitation and as the winter is open or severe. This sheet of water shifts with the wind. A north wind of much duration will pile up the water at the south end of the "lake" and virtually lay dry the road location. With a shift of wind, the piled-up water comes flooding back and submerges the highway location sometimes several inches deeper than normal.

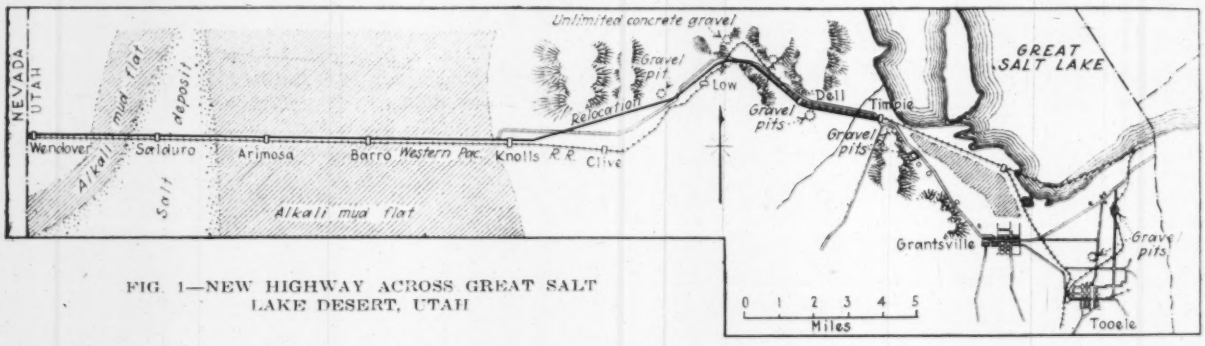


FIG. 1—NEW HIGHWAY ACROSS GREAT SALT LAKE DESERT, UTAH

Under these conditions the design and construction problems became different at different points. Where the salt crust overlay the mud the problem was quite different than on the uncovered mud. Moreover the mud varied in consistency. In the deeper part of the lake, or near the salt bed, where winter submergence was usual and where in summer the water table was at the surface, the mud was soft—"would bog a saddle blanket" says Howard C. Means, state highway engineer. Toward the shore, with the lowered water table of summer, the mud dried out so that teams could work on it. Again the wind movement introduced the problems of wave action and of providing means of flow back and forth through the embankment.

Two other conditions affecting design and construction were the location of the Western Pacific R.R., alongside the road route and the salt and potash works, at Salduro, of the Utah-Salduro Co. The railway, a fill across the lake, made by hauling in from the ends and dumping onto the mud, indicated first the certain stability of a fill on the mud flats and the salt bed and of course gave an excellent means of access. The salt works had accumulated, in dike building, a fund of information of direct value in building road embankment as is subsequently explained.

Design and Structure—Obviously the only road structure to consider was an embankment. To construct this embankment of hauled-in material, as was the adjacent Western Pacific R.R. roadbed, put a cost on the road which could not be borne. It must be built from borrow. In design three things, besides the regulation requirements of a road grade, had to be considered. The fill had to be kept well above any probable height of water, it had to provide for back and forth flow of water, and it had to withstand wave action.

Considering the final requirement first, it was decided that a 1 on 6 graveled slope on the north side and a 1 on 3 slope on the opposite side, where the railway grade served as a breakwater, would be safe against wave damage. The top width was put at 24 ft., and the height at generally about 3 ft. above the surface. To pass the water flow, culverts were plentifully provided. Because of the alkaline and salt soil and water, metal or concrete structures were out of consideration. In these conditions, however, wood would be preserved, so 81 wood culverts and 6 pile bridges were built. The culverts were made of 6 x 12-in. timbers fastened by wood pins. The culvert ends were beveled to the embankment slope and exposed surfaces were painted with creosote. The road surface was gravel 18 ft. wide and 2½ : 8 : 2½ in. in section. The north slope was also graveled to reduce wash of the waves.

Construction Plan—To build this embankment of borrow required using the mud of the "lake" bottom or flats. This was clay. For 6½ miles it was under a crust of salt. In the submerged area (winter high water) it was soft, but considerably softer in some spots than in others. Outside the submerged area the soil was fairly hard in summer when the water table fell. Here teams could work. The animals, however, had to be stabled

on platforms raised above the surface and even slight scratches, inflamed by alkali, soon disabled them. In brief, construction was a machine operation and the first planning was to discover the machine and the method. The salt-crusted section was first considered

At Salduro on the salt island the salt company, as stated, had done much dike building. Altogether it had

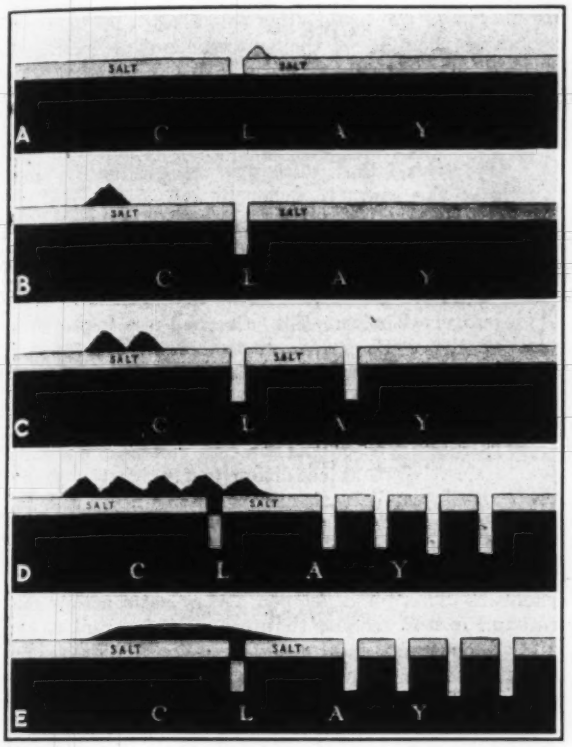


FIG. 2—SEQUENCE OF GRADING OPERATIONS ON SALT FLATS SECTION

A—Temporary waste pile of salt is placed in windrow on north side of trench.
B—Clay is removed from trench and placed in windrow for embankment. Salt is backfilled into bottom of trench.
C—Salt cut of second trench is wasted into first trench. A second windrow of clay is then placed from second trench.
D—Five trenches necessary to furnish sufficient clay for embankment. Windrows of clay completed prior to leveling. Key trench filled with clay to bottom of salt plane to prevent flow of fresh water under embankment and the resulting undermining of roadway.
E—Completed roadway with 18-ft. gravel surfacing, and 1 on 6 gravel slope on north side.

built some 700 miles of dikes enclosing evaporating basins and had developed equipment and processes to meet the conditions. Briefly it had found that to build a stable dike wall, the salt crust must be trenched and cleaned out to the clay bed and the clay dike built by filling from the bottom of the trench to dike level. The clay for the fill came from under the salt of a parallel trench and trench excavators were the machines employed. If the clay dike was built on the salt crust it was undermined by the winter high water which melted out the salt foundation. This experience applied directly to building the road embankment across the salt field. There was no question of the strength and stability of the salt crust as a base for the embankment providing the fresh water could not get at it.

Based on the dike building procedure described, the construction plan across the salt island was developed as indicated by Fig. 2 reading the sketches from top to bottom. First a trench under one side of the embankment was cut through the salt crust and the excavated salt was piled up alongside. This situation is shown by sketch *A*. Then the trench was deepened and the clay was piled in a windrow along the far edge of the embankment base. The windrow of salt was then backfilled into the trench. This situation is shown by sketch *B*. A second cut was then made, the salt being thrown directly into the first trench and the clay placed in a second windrow in the embankment. This operation was repeated until there were five trenches and five windrows in the embankment, the salt cut going into a preceding trench and the clay cut going into the road. It will be noted that the first trench was backfilled with salt only to a level just below the clay surface; then the top part was backfilled with clay. This gave, as shown by sketch *D*, the core wall which prevented water from seeping through the salt under the road and undermining it. Finally the clay windrows were graded down to form the road embankment, sketch *E*.

On the mud flats, as has been noted, various conditions prevailed. In the dryer parts near shore, team grading was possible. For the wetter portions, generally, the trench plan, as on the salt island, was adopted. The trench excavator work, however, in very soft spots was supplemented by draglines and clamshell excavators.

Working Conditions and Plant—Simple as the construction plan was, it was complicated by an unusually troublesome set of working conditions. The winter overflow and the shifting of the water under wind action have been noted. In the winter of 1923-4 the overflow was 14 in. Freezing weather and almost continuous winds prevailed. Often the thermometer registered zero. The water, being brine (26 per cent salt), did not freeze but it was qualifiedly cold. Altogether, indeed, few combinations of winter work conditions offer a more uncomfortable situation than existed here, but work continued night and day.

As stated, trench excavators were the main equipment for embankment construction. For the salt bed work a No. 10, 50-ton wheel-type Buckeye trench excavator digging 3 ft. wide and 12 ft. deep or about 1 cu.yd. per trench foot was employed. Due to the weight of this machine the trenches could not be spaced closer than 10 ft. On the mud flats a similar but smaller (3x9 ft. cut) No. 9 excavator with extended crawler tractions was mainly used. Both machines with their fittings constituted rather remarkable outfits.

The belt conveyor attached to the machine proper was only 12 ft. long. In transporting the excavated clay from the several trenches, it was necessary to use a portable belt conveyor, Figs. 3 and 4, driven by an independent power unit which would move along the fill at the same speed the trencher traveled, the length of the conveyor being determined by the location of the trencher with respect to the point on the embankment where clay was to be deposited. In the trenches farthest north this belt conveyor was lengthened to 72 ft., making a total length of 84 ft. the clay was carried by this means. This belt conveyor was a separate machine driven by an automobile engine remodeled to fit the requirements for driving the belt. In the trenches near the fill where it was not necessary to lengthen out the conveyor this machine was attached to the front of the trencher by means of a wire cable. This proved a very satisfactory means of locomotion until the length of conveyor increased so the draft pulled the front of

the trencher off the line of cut, which had been established by the removal of the salt. In order to remedy this, a large timber 60 ft. in length was floated in the trench ahead of the machine, the back end butting against the front of the trencher and the front end on a small platform that worked against the side of the salt cut. To this was fastened the cable attached to the conveyor and, the angle of draft being changed, everything moved along smoothly.

At another point the underlying clay was so soft, approaching a semi-liquid form, that it ran back around the wheels of the conveyor in such a manner as to block any movement. This was remedied by placing two large timbers under the axle of the machine and rigging a set of baffle boards in such a way as to use the force of the flowing mud, as it was deposited off the end of the belt, to force the machine forward. This operated so successfully that nearly all tension was removed from the cable attached to the trencher.

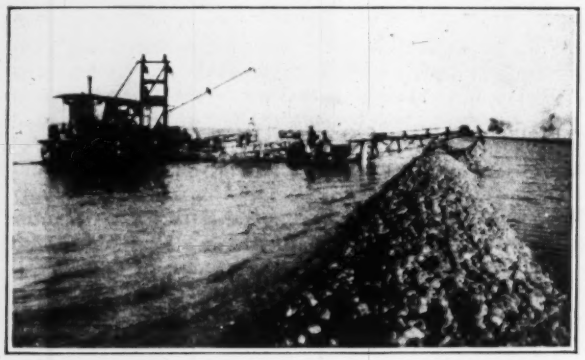


FIG. 3—PLACING FIRST WINDROW IN EMBANKMENT
Wheel-type trench excavator delivers to belt conveyor reaching to embankment and traveling along fill with excavator.

The trencher No. 10 used on the salt section performed remarkable work when running, but many difficulties required heavy repairs which necessitated closing down for long periods of time. This machine made a 3,800-ft. salt cut in one 24-hr. period and a 2,700-ft. clay cut in another 24-hr. period. As stated, a No. 9 trencher, remodeled to fit conditions, was used on the mud section. Still another trencher of the ladder type was used on the section in the vicinity of Arinosa. This was a P. & H. machine making a 42-in. cut 12 ft. in depth, but with the added difficulty of requiring the brine to be pumped from the trenches back of the machine. A No. D-5 Austin dragline machine and a P. & H. No. 206 dragline with 38-ft. boom were used in an especially soft part of the flat. A P. & H. crane machine with a clamshell bucket filled out the embankment where the trenchers had not delivered sufficient material. A 75-hp. Holt caterpillar attached to a Russell grader leveled the embankment in addition to moving other heavy machinery around as required. Another tractor was remodeled and used in connection with a steam piledriver in building the bridges. Three other tractors were used in connection with graders and levelers. A loader was used for the loading of the gravel along the railroad grade into Ford trucks which were equipped with 1½-yd. dump bodies. Wheelers and fresnos were also used in moving gravel from the railroad to the highway. It is interesting to know that in constructing this project the value of the equipment used was in excess of $110,000.

Leveling and Surfacing—The clay used in the embankment, both on the mud flat and the salt bed, was a very fine-grained material, about a 200-mesh, and when dry developed about 50 per cent of voids, in this respect being very similar to Portland cement. When this mass became saturated it held a considerable amount of moisture; being of fine grain, it did not dry out readily even when exposed to the sun. After the salt cuts were made and the underlying clay thrown up in windrows along the line of the embankment, it took considerable time for the surface to dry out sufficiently to permit a caterpillar and grader to work upon it. The hot sun working on this mass for weeks would not dry it out to exceed a depth of a quarter of an inch. It was demonstrated that wind was more effective than the rays of the sun. In order to expose as great an area as possible it was necessary to aerate the mass continuously with plows, graders and drags. By persistent working the clay was finally put into satisfactory shape for the surfacing.

As a matter of information, a record was kept of the extent of the work necessary to accomplish this result on a certain 2-mile section east of Salduro. Two tractors worked on this stretch, one a small tractor attached to a blade, the other was a somewhat larger tractor pulling a leveler. In working this 2-mile section down to a satisfactory condition to receive the gravel surfacing, the small tractor traveled 210 miles and the larger tractor 156 miles.

Gravel for the surfacing for the west 4 miles of the project was secured from the pit near the town of Wendover. This pit developed a very satisfactory material and it was used on the project as far east as the limits of economical haul would permit. The gravel for the remainder of the project was delivered by the Western Pacific Ry. from a railroad pit about 12 miles west of Wendover. This gravel was dumped along the north side of the track in windrows and stock piles opposite the point on the highway where it was to be used. The delivery of this 75,000 cu.yd. of gravel was undertaken by the Western Pacific. A steam-shovel crew was placed in the pit, and work trains equipped with Lidgerwood machines, working night and day, hauled this gravel to the project. The railroad company completed this work in a very satisfactory manner, at a delivery price of 95c. per cubic yard. The project is indebted to the Western Pacific for the contribution carried in this very low rate, which was estimated as approximately $40,000.

Personnel—The work was carried out as a federal-

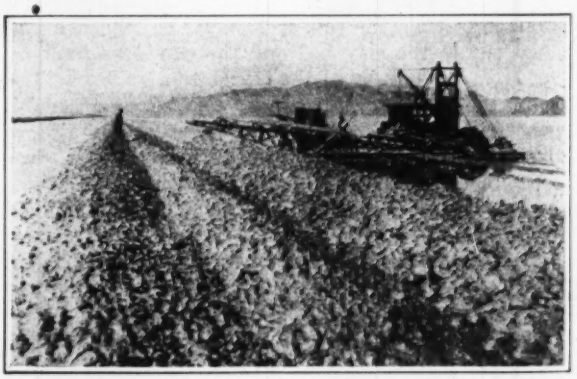


FIG. 4—PLACING THIRD WINDROW IN EMBANKMENT
Note as in Fig. 3 trench excavator operating in a foot or more of water.

FIG. 5—LINES OF TRENCHES FOR BUILDING EMBANKMENT

aid project under the direction of Howard C. Means, chief engineer, Utah State Road Commission; this article has been prepared from information furnished by him. The work was done under two contracts—one for grading the salt island section and another for grading the mud flats portion and gravel surfacing both sections. The contractors for the salt bed section were a group of men of the Utah-Salduro Co. and those for the remainder were a group composed of the first group and men from a well-known firm of contractors. The total cost of the road was $380,000 or $9,164 a mile.

New Gravity Water Supply in Use at Charlottesville, Va.

Slow Sand Filters Meet Conditions Common in State of Virginia—Boosters for Stored Water in Very Dry Weather

By Lee H. Williamson
Consulting Engineer, Charlottesville, Va.

CHARLOTTESVILLE, the home of the University of Virginia, turned on a new water supply March 30, 1925. The improvements include an intake dam, a pipe line connecting with the old supply mains, booster pumps and slow sand filters. Normally the supply is by gravity, direct to the distribution system, with the excess sent to old storage reservoirs from which in extremely dry weather the booster pumps mentioned further on lift the stored water to the filters.

The old water supply was from a drainage area of 1.9 sq.mi., impounded in two reservoirs with a combined capacity of 670 m.g., located near the city. In 1921 depletion and prolific algal growths rendered the supply practically unpotable and delivery pressures were materially affected, so booster pumps and a slow sand filter, with aeration before and after filtration, were installed at this time, with a view to their use as a part of works for a permanent additional supply. In 1923, further depletion demanded immediate action. Moormans River, a mountain stream flowing from the Blue Ridge, was found to be the most economical source, capable of expansion to probable requirements. Pending the development of this source an emergency supply was pumped in from Maury's Creek. In February, 1924, contracts were let to develop the Moormans River source, work on which was recently completed.

The diversion dam, with a gravity overflow masonry section, is 150 ft. long and 11 ft. high. Immediately below it is a grit chamber, with flow velocity of ½ ft. per sec., for the removal of the heavier flood-flow turbidity. The supply main, 72,000 ft. long, is of 18-in. cast-iron pipe with leadite joints. Due to the rolling topography, relatively short sections can be drained by blow-off valves, so the line is designed for pressure from the hydraulic gradient and flow is controlled only at the intake. Immediately below the original reservoirs this main connects with the old mains leading to the slow sand filter plant. Just above the reservoirs, on the hydraulic gradient, a small concrete control chamber allows the excess of capacity over demand to overflow to the storage reservoirs, and prevents static head on the line. Connections with the old mains are sufficiently elastic to allow maximum usage of gravity flow during the dry season, while any deficiency is boosted to the filters from the reservoirs.

The filtration plant, with a capacity of 2.5 m.g.d., is designed for a 5-m.g.d. rate. It has operated very successfully and economically, giving an unusual color reduction and averaging 13 weeks between scrapings. The reason for using slow instead of rapid filters deserves a few words, chiefly because there are many similar local conditions in Virginia which presumably can best be met by slow sand filters. In the Charlottesville case, the water from the old impounding reservoirs had a low turbidity and only a fairly high color. The new supply from Moormans River carries practically no turbidity except that due to fairly large particles in suspension at times of flood flow, to remove which the grit chamber was provided. This water has a very low color value, seldom, if ever, exceeding 25. The drainage area is inhabited, although it is soon to become a part of a national forest. Both waters are very soft and very low in mineralization. There was no correction necessary which could not be adequately handled by slow sand filters and even in the face of increased first costs over that of mechanical filters, the operating economy of the slow sand type was considerable.

The total capacity of the new system is 4 m.g.d., which can be increased to 7 m.g.d. by the construction of an impounding dam at the intake and additional mains. The average draft for 13,000 population is 1.3 m.g.d. The cost of the filtration plant was $170,000 and of the head and control works and supply main, $510,000, or a total of $680,000 for the new system.

Boyd A. Bennett is city manager. The work was carried out under the direction of the writer as designing and supervising engineer, with Fuller & McClintock, New York City, as consulting engineers. The F. E. Hartman Co., Inc., was contractor for the Moormans River development and the W. P. Thurston Co., of Richmond, for the purification plant.

Surveys of Hydraulic Power in France

Estimates of the available hydraulic power in France have been arrived at by the surveys of the Service des Grandes Forces Hydrauliques, whose operations extend through the French Alps, the Pyrenees, and the Massif Central of mid-France. Maps have been prepared on a scale of 1 in 50,000 which give details of the principal waterways and profiles of the rivers. From these it is estimated that the total low flow will produce 4,600,000 hp. and the normal flow over 9,000,000 hp. The latest figures, those for 1923, give a total of 2,100,000 hp. developed compared to 620,000 hp. in 1903.

U. S. Supreme Court Rules Against Labor Court

Decision on Kansas Court of Industrial Relations Apparently Permanently Invalidates Compulsory Arbitration

TEXT of the decision of the U. S. Supreme Court, on April 13, 1925, in the case of the Chas. Wolff Packing Co. vs. the Court of Industrial Relations of the State of Kansas shows that that experiment in adjusting controversies between capital and labor is not considered constitutional by our highest court. The case at issue was an appeal from a ruling of the Supreme Court of Kansas validating certain specific rulings of the Industrial Court in the operating of a small packing house of the Wolff Co. An earlier U. S. Supreme Court decision (*Engineering News-Record*, June 21, 1923, p. 1102) ruled in effect that the Industrial Court had no control over wage regulation in these industries not "clothed with public interest." The latest decision goes much further and apparently invalidates the whole act creating the Industrial Court.

The pertinent text is as follows:

Purpose of Act—The declared and adjudged purpose of the Act is to ensure continuity of operation and production in certain businesses which it calls "essential industries." To that end it provides for the compulsory settlement by a state agency of all labor controversies in such businesses which endanger the intended continuity. It proceeds on the assumption that the public has a paramount interest in the subject which justifies the compulsion. The businesses named include, among others, that of manufacturing or preparing food products for sale and human consumption. The controversies to be settled include, among others, those arising between employer and employees over either wages or hours of labor. The state agency charged with the duty of making the settlement is the Court of Industrial Relations. Although called a court it is an administrative board. It is to summon the disputants before it, to give them a hearing, to settle the matter in controversy—as by fixing wages or hours of labor where they are what is in dispute—to embody its findings and determination in an order, and, if need be, to institute mandamus proceedings in the supreme court of the state to compel compliance with its order. The order is to continue in effect for such reasonable time as the agency may fix, or until changed by agreement of the parties with its approval. The employer may discontinue the business (a) where it can be conducted conformably to the order only at a loss, or (b) where for good cause shown the agency approves; and individual employees may quit the service in the exercise of a personal privilege, but may not induce others to quit or combine with them to do so. With these qualifications both employer and employees are required to continue the business on the terms fixed in the order, violations and evasions being penalized. The authority given to the agency to fix wages or hours of labor is not general, nor is it to be exerted independently of the system of compulsory settlement. On the contrary, it is but a feature of that system and correspondingly limited in purpose and field of application. No distinction is made between wages and hours of labor; both are put on the same plane. In the fixing of wages regard is to be had for what is fair between employer and employees, and in the fixing of hours of labor regard is to be had for what are healthful periods; but neither is to be fixed save in the compulsory adjustment of an endangering controversy to the end that the business shall go on.

The following excerpt from the opinion of the supreme court of the state in *State ex rel.* v *Howat*, 109 Kan. 376, 417, explains the pervading theory of the act:

"Heretofore the industrial relationship has been tacitly regarded as existing between two members—industrial manager, and industrial worker. They have joined wholeheartedly in excluding others. The legislature proceeded on the theory there is a third member of those industrial relationships which have to do with production, preparation and distribution of the necessaries of life—the public. The legislature also proceeded on the theory the public is not a silent partner. When the dissensions of the other two become flagrant, the third member may see to it the business does not stop."

On three occasions when the act was before us we referred to it as undertaking to establish a system of "compulsory arbitration." The supreme court of the state in a recent opinion criticizes this use of the term "arbitration." We recognize that in its usual acceptation the term indicates a proceeding based entirely on the consent of the parties. And we recognize also that this act dispenses with their consent. Under it they have no voice in selecting the determining agency or in defining what that agency is to investigate and determine. And yet the determination is to bind them even to the point of preventing them from agreeing on any change in the terms fixed therein, unless the agency approves. To speak of a proceeding with such attributes merely as an arbitration might be subject to criticism, but we think its nature is fairly reflected when it is spoken of as a compulsory arbitration. Of course, our present concern is with the essence of the system rather than its name. In this connection it is well to observe that in the opinion last mentioned the state court recognizes that the system, while intended to be just between employer and employees, proceeds on the theory that the public interest is paramount, as was explained in *State ex rel.* v. *Howat*, *supra*.

What Is Public Interest—The survey just made of the act, as construed and applied in the decisions of the supreme court of the state, shows very plainly that its purpose is not to regulate wages or hours of labor either generally or in particular classes of business, but to authorize the state agency to fix them where, and in so far as, they are the subjects of a controversy the settlement of which is directed in the interest of the public. In short, the authority to fix them is intended to be merely a part of the system of compulsory arbitration and to be exerted in attaining continuity of operation and production.

When the case was first here the question chiefly agitated, and therefore discussed and decided, was whether the authority to fix wages as an incident of the compulsory arbitration could be applied to a business like that of the Wolff company consistently with the protection which the due process of law clause of the Fourteenth Amendment affords to the liberty of contract and rights of property. The question was answered in the negative and the act was held invalid in so far as it gives that authority. The subject was much considered and the principles applied were distinctly stated.

At the outset the court pointed out that the act assumes as a "necessary postulate" that the state, in the interest of the public, "may compel those engaged in the manufacture of food and clothing, and the production of fuel, whether owners or workers, to continue in their business or employment on terms fixed by an agency of the state if they cannot agree." Then, after referring to the limited privilege of withdrawing from the business or employment which the act accords to owners and employees who may be dissatisfied with the determination, the court said:

"These qualifications do not change the essence of the act. It curtails the right of the employer on the one hand, and of the employee on the other, to contract about his affairs. This is part of the liberty of the individual protected by the guarantee of the due process clause of the Fourteenth Amendment. While there is no such thing as absolute freedom of contract and it is subject to a variety of restraints, they must not be arbitrary or unreasonable. Freedom is the general rule, and restraint the exception. The legislative authority to abridge can be justified only by exceptional circumstances."

Various matters which were relied on as justifying the attempted restraint or abridgment were considered and pronounced inadequate. Among them was the assumption in the Act that a business like that in question—preparing food for sale and human consumption—is so far affected with a public interest that the state may compel its continuance, and, if the owner and employees cannot

agree, may fix the terms through a public agency to the end that there shall be continuity of operation and production. This assumption was held to be without any sound basis and its indulgence by the state legislature was declared not controlling. The court recognized that in a sense, all business is of some concern to the public and subject to some measure of regulation, but made it plain that the extent to which regulation reasonably may go varies greatly with different classes of business and is not a matter of legislative discretion solely, but is a judicial question to be determined with due regard to the rights of the owner and employees. Care was taken to point out that operating a railroad, keeping an inn, conducting an elevator and following a common calling are not all in the same class, and particularly to point out the distinctions between a quasi-public business conducted under a public grant imposing a correlative duty to operate, a business originally private which comes to be affected with a public interest through a change *in pais*, and a business which not only was private in the beginning but has remained such. The conclusion was that power to compel the continuance of a business because affected with a public interest is altogether exceptional. On this subject the Court said:

"An ordinary producer, manufacturer or shopkeeper may sell or not sell as he likes, and while this feature does not necessarily exclude businesses from the class clothed with a public interest, it usually distinguishes private from quasi-public occupations.

"It involves a more drastic exercise of control to impose limitations of continuity growing out of the public character of the business upon the employee than upon the employer; and without saying that such limitations upon both may not be sometimes justified, it must be where the obligation to the public of continuous service is direct, clear and mandatory and arises as a contractual condition express or implied of entering the business either as owner or worker. It can only arise when investment by the owner and entering the employment by the worker create a conventional relation to the public somewhat equivalent to the appointment of officers and the enlistment of soldiers and sailors in military service.

"The penalties of the act are directed against effort of either side to interfere with the settlement by arbitration. Without this joint compulsion, the whole theory and purpose of the act would fail. The state cannot be heard to say, therefore, that upon complaint of the employer, the effect upon the employee should not be a factor in our judgment.

"The power of a legislature to compel continuity in a business can only arise where the obligation of continued service by the owner and its employees is direct and is assumed when the business is entered upon. A common carrier which accepts a railroad franchise is not free to withdraw the use of that which it has granted to the public. It is true that if operation is impossible without continuous loss, it may give up its franchise and enterprise, but short of this, it must continue. Not so the owner [in another field] when by mere changed conditions his business becomes clothed with a public interest. He may stop at will whether the business be losing or profitable."

Applying these principles, the court was of opinion that the business in question is one which the state is without power to compel the owner and employees to continue.

Law Generally Invalid — On further reflection we regard the principles so stated and applied as entirely sound. They are as applicable now as they were then. The business is the same and the parties are the same. So we reach the same conclusion now that we reached then.

The system of compulsory arbitration which the act establishes is intended to compel, and if sustained will compel, the owner and employees to continue the business on terms which are not of their making. It will constrain them not merely to respect the terms if they continue the business, but will constrain them to continue the business on those terms. True, the terms have some qualifications, but as shown in the prior decision the qualifications are rather illusory and do not subtract much from the duty imposed. Such a system infringes the liberty of contract and rights of property guaranteed by the due process of law clause of the Fourteenth Amendment. "The established doctrine is that this liberty may not be interfered with, under the guise of protecting the public interest, by legislative action which is arbitrary or without reasonable relation to some purpose within the competency of the state to effect."

The authority which the act gives respecting the fixing of hours of labor is merely a feature of the system of compulsory arbitration and has no separate purpose. It was exerted by the state agency as a part of that system and the state court sustained its exertion as such. As a part of the system it shares the invalidity of the whole. Whether it would be valid had it been conferred independently of the system and made either general or applicable to all businesses of a particular class we need not consider, for that was not done.

It follows that the state court should have declined to give effect to any part of the order of the state agency.

Tunnel Under Ship Channel Proposed at Duluth

A PROJECT for a street tunnel under the ship channel into the inner harbor between Duluth and Superior has been advanced by W. H. Tischer, commissioner of public works of Duluth. The tunnel would cross on the line of the present railroad and street swingbridge on Conner's Point, rather than by way of Park Point, as the former gives a more direct connection between the centers of the two cities and is thought particularly advantageous in view of the steady westward growth of the Duluth business district. Traffic over the bridge now averages nearly 3,000 vehicles daily, which represents a ninefold increase in ten years. The navigation demands require the bridge to be open from 2 to 7 hr. per day, often for periods of a large fraction of an hour at a time. Collisions of vessels with the bridge have interrupted communication on three or four occasions during the last twenty years, the most recent on Nov. 20, 1924, when the shore span on the Superior side was knocked into the river by a colliding freighter.

Estimates for a highway tunnel indicate a cost of about $4,000,000. The present bridge toll income is about $200,000 annually. With the present traffic increase it is estimated that a tunnel would almost from the first yield a surplus, assuring early amortization. Mr. Tischer states (Bulletin of the Minnesota Federation of Architectural and Engineering Societies, February, 1925) that Duluth and Superior are not able to finance the project themselves and that it must be built by private capital obtained outside. Assurances have already been obtained that outside interests will undertake the construction and operation of the tunnel on a 25-year charter, provided a certain amount of local capital is contributed.

The bridge, which now forms the only traffic connection across Conner's Point, was built by the Great Northern R.R. 28 years ago, at a cost of something over $700,000. It was agreed at the time of construction that when the tolls collected should amount to enough to pay for the investment, the bridge would be made a free highway. Tolls are still being collected, however.

To Survey Flood Control in Washington

Flood control surveys on the Skykomish River, Snoqualmie River, Snohomish River, and Stillaguamish River, all in Snohomish County, Washington, and the Nooksack River in Whatcom County, Washington, have been ordered by Congress.

Strengthening and Re-Decking Old Bridge for Heavy Traffic

Saving Due to Reconstructing Instead of Replacing Harvard Bridge Will Pay for Work in Seven Years—New Deck of Heavy Plank with Granite-Block Surfacing and High Reinforced-Concrete Curb

By Lewis E. Moore
Consulting Engineer, Boston

THE HARVARD Bridge in Boston, completed in 1891, was rebuilt and modernized during the past year under rather interesting circumstances. It crosses the Charles River between Boston and Cambridge on the line of Massachusetts Ave., its Cambridge end passing the Massachusetts Institute of Technology. It is 2,166 ft. long and has a 51-ft. roadway and two 10-ft. overhanging sidewalks, except that over the drawspan the roadway is 34 ft. wide for a 149-ft. section.

With the exception of the drawspan the structure consists of four lines of cantilevered wrought-iron plate girders, generally with twenty-three alternate long and short spans of 105 ft. 3½ in. and 75 ft. 2½ in. respectively. The original construction included wrought-iron floorbeams and wooden stringers, carrying a 3-in. plank floor. Each 75-ft. suspended girder is hung from the cantilever girders by two 4 x 1-in. eyebars, with 4-in. pins. Except for the draw pier, which was wholly of wood, the piers were in most cases built on piles cut off at the mud line; the shafts were concrete below and granite above. The drawspan consisted of two plate-girders 35 ft. apart, bearing through two cross girders on a central drum.

Floor Troubles—The first wooden plank flooring did not stand up well under traffic. Many different wooden pavements were later applied, but none gave satisfactory service. The last, laid in 1918, consisted of laminated maple strips fastened together. It was impossible to fasten it permanently to the lower layer of planking, and the pieces were continually coming loose, sometimes jumping completely out of place, thus leaving holes in the floor. The whole pavement rattled so that the bridge was popularly known as the "xylophone" bridge. The curb was very low, being only the thickness of the sidewalk planks, and as a result it was not uncommon for an automobile to go through the bridge rail into the river.

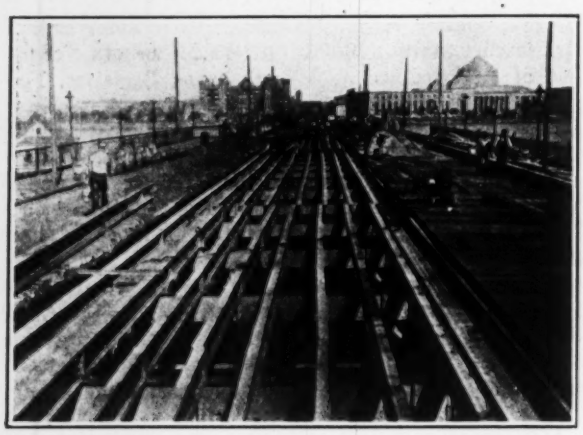


FIG. 1—OLD AND NEW FLOORING OF HARVARD BRIDGE
View looking toward Technology buildings in Cambridge. At left, old roadway; in center, new I-beam stringers, lapped at expansion joints; at right, new 6-in. planking and 12-in. concrete curb. New planking was laid in three longitudinal strips. At joint between strips a built stringer was used, to give bearing for ends of adjacent planks.

Repair or Renewal—These conditions were so bad that the state legislature of 1923 authorized the Metropolitan District Commission to investigate both renewal and reconstruction of the bridge. Studies for a new bridge were made by Robert D. Andrews, architect. The Metropolitan District Commission engaged the writer to investigate the feasibility of repairs. The estimated cost of a new bridge, together with a temporary bridge for use during construction, was $3,000,000. The interest on this at 4½ per cent is $135,000. The estimated cost of reconstructing the present bridge was $558,000, with an estimated annual cost (maintenance, interest and depreciation) of $45,000. It was seen that reconstructing and repairing the existing bridge would yield a saving in fixed charges sufficient to absorb the total cost of repairs in seven years. The legislature thereupon directed the Metropolitan District Commission to repair the bridge.

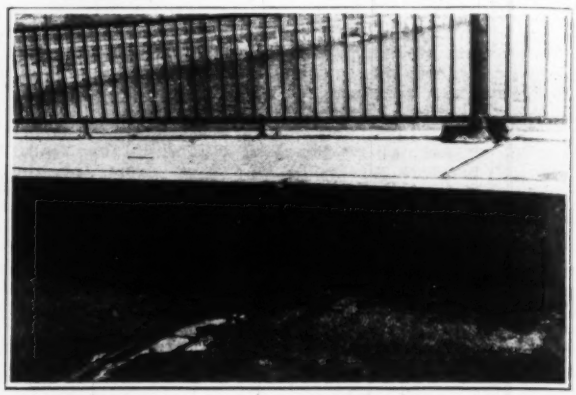


FIG. 2—GRANITE PAVEMENT CURB, WALK AND RAILING AT EXPANSION JOINT
Steel angles bolted to 6-in. plank under floor serve as curbing for the granite-block pavement. The 12-in. curb is intended to keep vehicles on the roadway.

An important part of the reconstruction was widening the roadway over the drawspan from 34 to 51 ft. so as to present an unbroken highway of even width for the whole length of the structure. This could be done at reasonable cost because, the drawbridges above the Charles River dam having been gradually dispensed with since construction of the dam, the War Department consented to elimination of the Massachusetts Ave. draw.

Load Conditions—The original bridge was designed for a dead-load of 30 lb. and a live-load of 100 lb. per square foot, making a total capacity of 130 lb. at 10,000 lb. per square inch compression, and 12,000 lb. tension in the ironwork. In planning the reconstruction it was believed that provision for 70 lb. live-load and a 20-ton truck at any point would be sufficient for highway traffic needs for a long time to come. This left 60 lb. available for the dead weight of the new stringers, flooring and pavement. These loads would not increase the original working stresses in the

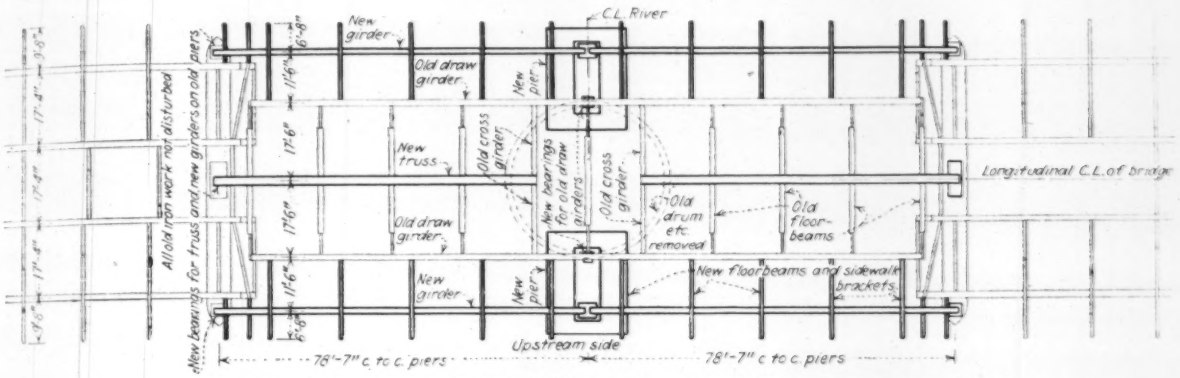


FIG. 3—WIDENING AND REARRANGING THE DRAWSPAN FRAMING
The 34-ft. roadway of the old draw formed a bad throat in the crossing. It was widened to the normal 51-ft. roadway width by adding girders and floorbeams.

wrought-iron girders, although the stresses in the wrought-iron floorbeams would be increased considerably by the load concentrations of trucks. However, as no loose rivets had developed even under the severe impact to which the floorbeams had been subjected owing to the bad condition of the pavement, and as the ironwork had thus proved itself adequate for present-day traffic, there was no reason for strengthening it when the result of the new pavement would be a greatly reduced impact as well as a much better distribution of the load.

Changes in Structure—Most of the ironwork was in excellent condition and needed only minor repairs. Stiffeners were added on the old floorbeams under the new stringers; these were fitted under the top flange only. The suspended-span hangers on the two central lines of girders, being too light for trains of street cars, were replaced by flat slabs 10 x 1½ in., with new and longer pins substituted for the old ones, though the old pin nuts were used. As a matter of interest, the old pins still showed the tool marks on their wearing surfaces, which indicated very slight wear in spite of the marked vibration of the structure.

I-beam stringers were substituted for the old wooden stringers. These I-beam stringers were generally three panels or about 45 ft. long, placed so that the ends of stringers in adjacent lines broke joint, and riveted to each other through stiffeners at their ends so that each line of stringers was continuous for the length of each span. At the joint between the cantilever and suspended spans the I-beams were lapped past each other on top of a floorbeam, one set being riveted to the floorbeam and the other set free to slide upon it.

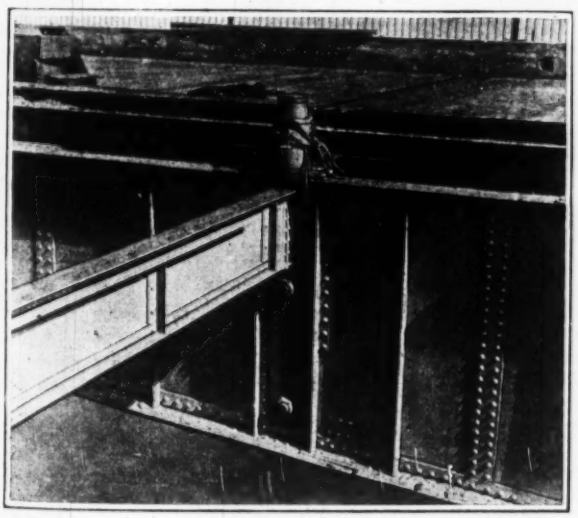


FIG. 4—NEW LINKS AT CANTILEVER CONNECTIONS
Old eyebars by which suspended spans were hung from ends of cantilever spans were replaced by plates of larger section, using new pins. Hydraulic jack standing on top of large girder was used to take reaction of span while placing new links.

Flooring—A plank floor of 6-in. transverse plank, serving as pavement base, was laid on these I-beams and bolted to each beam by a ¾-in. bolt with lock washers. This underflooring was laid in three longitudinal strips, 17 ft. 2 in., 19 ft. 7 in., and 17 ft. 2 in. wide. Short-leaf pine 6 x 10 in., tongue-and-grooved, of "merchantable inspection" quality, Interstate rules of 1905, was specified. It was not deemed wise to specify any better grade of lumber than could be obtained quickly in large quantities. The lumber was creosoted by the Boston Elevated Railway Co.

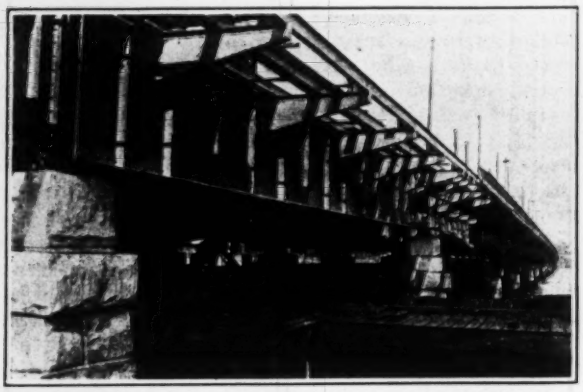
In the previous floor constructions on this bridge the planking and pavement had been laid continuously over the joints between the cantilever and suspended spans. Generally speaking, disintegration of the floor started at these points and worked progressively in both directions. In order to avoid this it was decided to make the planking and pavement entirely discontinuous at all these points. This was done by placing a 6 x 5½ x ¾-in. angle transversely of the roadway on each side of the joint and butting the pavement up against it, which left an inch or so between the pavements on the successive spans—an opening no greater than that at the ends of most draw-bridges, and in no way objectionable to traffic.

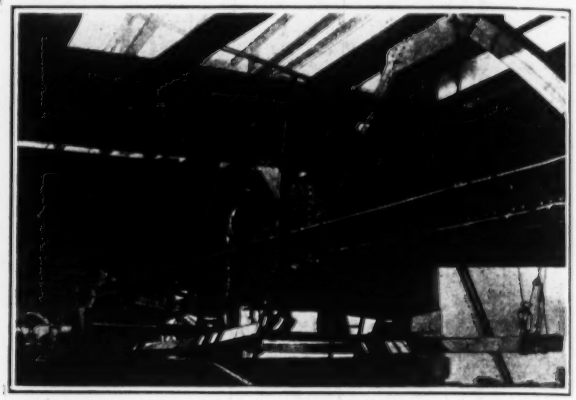
To stop rattles, U-bolt clamps were put at the intersections of the clevis-rod lateral and sway braces to hold them tight together. The stiffness of the continuous steel stringers and the tongue-and-grooved floor with each plank bolted to each stringer was relied upon to reduce the vibration. As a matter of fact the reconstructed bridge is noiseless and practically free from vibration.

Pavement—Several types of pavement were considered in the original report and it was decided to use vitrified brick, but this was afterwards changed to 3½ in. granite block. The block was set on asphalt mastic; asphalt filler was poured hot into the joints between the blocks. A grooved rail 4 in. high was

adopted by the Boston Elevated Railway Co. It was laid on ½-in. tieplates with screw spikes driven directly into the underflooring. Expansion joints were placed in the track about 350 ft. apart.

A curb 12 in. high was erected along the edges of the roadway and a 3-in. concrete-slab sidewalk on steel stringers was laid outside of the curb. The curb was longitudinally reinforced, and was cast on top of the planking and anchored to it by ¾-in. bars 3 ft. on centers. The curb height of 12 in. above pavement was determined by measuring the heights of hub caps and running boards on 34 makes of automobile; the lowest running board was 12½ in. from the ground. The sidewalk was kept at about its original grade, which makes its top about 9 in. below top of curb. There is thus a decided and very strong barrier between vehicles and pedestrians, which is proving very advantageous. The old railing was repaired.





FIGS. 5 AND 6—REARRANGEMENT OF DRAWSPAN AS FIXED SPAN

Left view shows new outer girder, near end, resting on new pier alongside old center-pier location. The girders of the old cantilever spans (beyond the draw) have bottom flanges curved to give arched appearance.

Right view shows center truss built into old draw girders. This truss is on the longitudinal center line of the bridge and supports the floorbeams at their mid-points. Its top chord also acts as a stringer.

Drawspan—The widening of the drawspan involved some difficulties. In the first place, new masonry piers were necessary in place of the old wooden center pier, which was in poor condition above the water line. All of the piles were carefully inspected by a diver and, as a result of their good condition under water, it was decided to put two new piers under the center of the draw, under the upstream and downstream girders respectively. New piles were driven between the old wherever there was room for them; and old and new piles were cut off below the water line and a timber platform built on them, with top just under the water level. A reinforced-concrete slab faced with granite was placed on top of this platform, and concrete piers faced with granite were built on the slab. Four new girders were placed, one end of each one resting on a new granite pedestal on the end of the pier adjacent to the draw, and the other resting on the new draw pier. New floorbeams were placed between old and new girders to support the widened roadway.

As this construction would result in overloading the old girders, they were relieved by two trusses along the longitudinal center line of the bridge, one at each end of the draw, extending from the rest pier of the draw to the cross-girder 11 ft. 8 in. from the center of the draw. These cross-girders, which originally transferred the load of the draw to the drum, were of ample strength to carry the reactions of the ends of the trusses out to the draw girders, which were also of sufficient strength between the two cross-girders to carry the moment due to these reactions. These trusses were erected around the floorbeams and the latter were wedged up on seats located between the diagonals. The trusses not only relieved the old draw girders by creating a new center support for the floorbeams, but also transferred some load from the ends of the rest piers to their centers, which was desirable because of the new load placed on the ends of these piers by the new girders used to widen the span. The top chords of the trusses were used as stringers. The drum and all its attendant parts were entirely removed and shoes placed on the new piers under the draw girders to carry them.

It was originally intended to maintain street-car traffic in both directions, and highway traffic toward Cambridge throughout the construction. A short time after construction was commenced conditions and delays became such that all except pedestrian traffic was discontinued throughout the work of construction. The detouring of traffic caused no particular hardship after the public became accustomed to it.

The contract was let on a unit-price basis. The

COST OF REPAIRING HARVARD BRIDGE

Steel stringers, 1,200 tons @ $93.50		$112,200
Planking (treated), 702 M bd.ft. @ $145.68		102,267
Railing repairs, 4,300 lin.ft.		21,357
Sidewalk (does not include steel stringers), 4,640 sq.yd.		24,005
Curb, 4,333 lin.ft.		8,813
Repairs to existing steel		1,824
New stiffeners in floorbeams and new hangers for floorbeam ties, 7,100 lin.ft. @ $2		14,200
Draw span:		
Steel girders	$7,292	
Piling 3,440 lin.ft. @ $1.25	4,300	
Cutting old piles, 64@$10	640	
Capping 5 M bd.ft. @ $120	600	
Planking 3 M bd.ft. @ $120	360	
Granite 82 cu.yd. @ $150	12,300	
Concrete 60 cu.yd. @ $35	2,100	
Bracing under water, 1,620 bd.ft. @ $200 M.	324	
Lining up old draw	1,822	
Cleaning up draw pier	400	
Removing old fender pier	14,612	
	$44,750	44,750
Pavement, 12,340 sq.yd. @ $7.63		94,168
Removal of old floor		10,000
Removing rubbish		244
Recutting and resetting parapets and regrading approaches		2,088
Watchmen and fire protection		3,814
Eyebar hangers, 84 @ $60		5,040
U-bolt clamps, 438 @ $1.25		548
Painting all steel work		20,000
Lighting equipment		7,000
Miscellaneous		4,682
Total		$477,000

accompanying statement of cost indicates about what may be expected in the way of cost for such work when completed. Insurance is included in the various unit prices. Engineering has not been shown. Figures have been rounded out.

The contract was let on July 10, 1924 to V. James Grande, of Boston, Mass. The Boston Bridge Works executed the subcontract for the steel. The contract date for completion was Dec. 31, 1924, and the work was completed at 9 p.m. on that date. The whole project was under the charge of John R. Rablin, chief engineer of The Metropolitan District Commission. The writer conceived and designed the method of reconstruction and acted as consulting engineer throughout the work.

Motor Vehicles Finance Wisconsin Highways

By J. T. Donaghey
State Highway Engineer, Madison, Wis.

UNIQUE features of the new highway law for Wisconsin, which was enacted this winter, are that no direct tax is levied for road work and that all roads and streets share in the distribution of the tax funds. By the new law we have an automobile license fee in the form of a weight tax, passenger cars paying from $10 to $26; trucks from $20 to $200, and motor buses three times the amount of a motor truck of like gross weight. This results in buses having 12-passenger capacity paying not to exceed $150 and those up to 25 passenger capacity not to exceed $350. The law provides for a 2c. tax on gasoline sold in the state after April 1, with an exemption for use other than for propelling motor vehicles on the highways. The revenues from these two sources are estimated to produce $13,000,000 in 1926. There is added to these two sums the federal aid annually available for Wisconsin, which is approximately $2,000,000, making a total fund for highway purposes of $15,000,000 without any direct tax.

The cost of administration is first set aside. There is then set aside $100,000 for marking the 10,000-mile state trunk highway system. There is next set aside approximately $4,000,000 for the maintenance of the 10,000-mile state trunk system. This is allotted to the different roads in the several counties according to their classification and traffic; that is, primary federal aid highways receive $500 per mile, secondary federal aid highways $400 per mile, and the balance of the state trunk system receives $300 per mile.

There is then set aside a certain sum per mile for roads and streets in all the units of government in the state as follows: Town roads and village streets not a part of the state or county trunk highway systems receive $25 per mile. This amounts to about $1,500,000. All city streets not a part of the state trunk highway system or marked as state trunk highways will receive in cities having a population not over 10,000, $50 per mile; in cities over 10,000 and not over 39,000, $100 per mile; in cities over 39,000 and not over 150,000, $150 per mile; and in cities over 150,000, $200 per mile. The last figure, of course, applies to Milwaukee only. These amounts allotted to the cities total approximately $500,000. In addition the cities receive for streets on the state trunk highway system the same amount per mile as the trunk highway entering the city receives; that is, if a city street is a part of the primary federal aid highway connection it receives $500 per mile; if it is a secondary federal aid highway connection it receives $400 per mile; and if an ordinary state trunk highway $300 per mile. The latter payments to the cities will amount to about $300,000, so that the cities will receive a total of approximately $800,000 for the maintenance of their streets.

The amount allotted to the towns and villages of $25 per mile will average somewhat over $1,000 per town. This will enable the town roads to be dragged after each rain, graded up occasionally, and kept in fairly good shape for the farmers living along them to reach the state and county trunk highways.

The county trunk highway system contains about 10,000 miles, and under the provisions of the law the county highways will receive approximately $200 per mile, which will maintain them in a very adequate manner.

The balance remaining, after the above deductions, is used for construction on the state trunk highway system, the required amount being used to meet federal aid available and the balance being allotted as state aid, and this will result in about $7,000,000 in 1926.

The counties have been appropriating about $5,000,000 a year in addition to the funds provided from the state and federal government. They will undoubtedly appropriate some funds in the future but they may not be as much under the provisions of the new law, for the reasons that the motor vehicle is paying a much greater proportion of the cost than heretofore.

We are very well satisfied with the new law and feel that it will provide a steady consistent program of both construction and maintenance for Wisconsin.

Strength of Sand-Lime Brick Walls

In tests of 8-in. and 13-in. walls built of sand-lime brick, just reported upon by the Bureau of Standards (Technologic Paper 276), very uniform results were obtained. The strength of sand-lime brick masonry with various kinds of mortar was determined. Walls laid in 1:3 lime-mortar showed average crushing strength of 310 and 290 lb. per sq.in. for 8-in. and 13-in. walls respectively; walls laid in 1:1:6 cement-lime mortar 675 and 575 lb. per sq.in.; and walls laid in 1:3 cement mortar 950 and 850 lb. per sq.in. The load at the appearance of the first crack ranged from 70 to 80 per cent of the ultimate strength. These walls were 6 ft. wide by 9 ft. high, and were laid in common bond (every sixth-course headers) with the workmanship of an ordinarily good job of brickwork; the horizontal joints were well filled, the vertical joints poorly or not at all. The modulus of elasticity calculated from the total compression at ordinary working load (which for the three classes was taken as 125, 200, and 250 lb. per sq.in.) was found to be, respectively, 100,000, 750,000, and 1,300,000 lb. per sq.in. The modulus of elasticity computed from the deformation occurring during release of the load and its reapplication was somewhat higher: 500,000, 1,100,000, and 1,300,000 lb. per sq.in. for the three classes, respectively. Higher strengths were obtained in tests of smaller wall sections ("wallettes"), about 18 in. long and 34 in. high; the strength of the wallette was one-fourth to one-half greater than that of the 6x9 walls.

Ohio Stream Pollution Law Amended To Give Increased Control

State Health Department Will Have Larger Powers Particularly Over Industrial Wastes— Streams May Be Classified

THE POWER of the Ohio State Department of Health to control stream pollution has been materially increased by amendments and extensions to the portion of the general legislative code (Sec. 1240) dealing with that subject. Except for minor amendments, the act, which was approved by the Governor on March 19, follows a bill drawn by an advisory committee on the correction of pollution of streams and water supplies, made up of representatives from the League of Ohio Sportsmen, the Izaak Walton League of America, Ohio Chapter, the Advisory Board, Division of Fish and Game, the Ohio Manufacturers Association, the Ohio Farm Bureau Federation, the Ohio State Grange, and the State Department of Health and the State Public Health Council.

The original Sec. 1240 prohibited the construction of water supply and sewerage systems, water and sewage treatment plants for which plans had not been submitted to and approved by the health authorities. The section also prohibited municipalities, corporations or persons from establishing "garbage disposal or manufacturing plants having a liquid waste which may enter any stream within 20 miles above the intake of a public water supply until the location of such garbage or manufacturing plant, including plans for disposing of such liquid waste, is approved by the State Department of Health." Sec. 1240, as amended, strikes out garbage and manufacturing plants, which are treated more fully in additional sections. The portion of Sec. 1240 dealing with sewage as contrasted with industrial wastes is enlarged by mentioning counties and institutions as well as cities and villages and by making the penalty more comprehensive. Of three additional sections to the code, one covers the approval of plans for plants to treat garbage disposal and industrial wastes, one provides for the supervision of the operation of plants for the treatment of sewage and industrial wastes, and one authorizes the State Department of Health to investigate water pollution generally throughout the state and to classify the streams of the state. Enforcement of the provisions of this section, we are informed by W. H. Dittoe, chief engineer, Ohio Department of Health, may be similar to that practiced by the Sanitary Water Board of Pennsylvania. The new legislation, in full, is as follows:

Sec. 1240. No city, village, county, public institution, corporation or officer or employee thereof or other person shall provide or install a water supply or sewerage, or purification or treatment works for water supply or sewage disposal, or make a change in any water supply, waterworks intake, water purification works, sewerage or sewage treatment works until the plans therefor have been submitted to and approved by the state department of health. This act shall apply to water supply, sewerage and purification or treatment works for water or sewage of a municipality or part thereof, an unincorporated community, a county sewer district or other land outside of a municipal corporation or any publicly or privately owned building or group of buildings or place, used for the assemblage, entertainment, recreation, education, correction, hospitalization, housing or employment of persons but shall not apply to water supply or sewerage or purification or treatment works for water or sewage installed or to be installed for the use of a private residence or dwelling, or to water supply for industrial purposes and not intended for human consumption. In granting an approval authorized by this section the state department of health may stipulate such modifications, conditions and regulations as the public health may require. Any action taken by the director of health shall be a matter of public record and shall be entered in his journal. Whoever violates any provision of this section shall upon conviction thereof be fined not less than $100 nor more than $500 for each offense, and a separate offense shall be deemed to have been committed for each period of 30 days such violation shall continue after such conviction.

Sec. 1240-1. No city, village, county public institution, corporation or officer or employee thereof or other person shall establish as proprietor, agent, employee, lessee, or tenant, any garbage disposal plant, shop, factory, mill, industrial establishment, process, trade or business, in the operation of which an industrial waste is produced, or make a change in or enlargement of a garbage disposal plant, shop, factory, mill, industrial establishment, process, trade or business, whereby an industrial waste is produced or materially increased or changed in character, or install works for the treatment or disposal of any such waste until the plans for the disposal of such waste have been submitted to and approved by the state department of health. For the purposes of this act industrial waste shall be construed to mean a water carried or a liquid waste resulting from any process of industry, manufacture, trade or business, or development of any natural resource. In granting an approval authorized by this section the state department of health may stipulate such modifications, conditions and regulations as the public health may require. The state department of health shall not exercise any authority under the provisions of this section in any municipal corporation wherein ordinances or resolutions have been adopted and are being enforced by the proper authorities to make effective the provisions of this section. Any action taken by the director of health shall be a matter of public record and shall be entered in his journal. Whoever violates any provision of this section shall upon conviction thereof be fined not less than $100 nor more than $500 for each offense and a separate offense shall be deemed to have been committed for each period of 30 days such violation shall continue after such conviction.

Sec. 1240-2. The state department of health shall exercise general supervision of the disposal of sewage and industrial wastes and the operation and maintenance of works or means installed for the collection, treatment or disposal of sewage and industrial wastes. Such general supervision shall apply to all features of construction, operation and maintenance of such works or means which do or may affect the proper treatment or disposal of such sewage and industrial wastes. For the purpose of exercising such general supervision the state department of health shall investigate the works or means employed in the collection, treatment and disposal of sewage and industrial wastes whenever deemed necessary by the department and whenever requested to do so by local health officials; and may adopt and enforce orders and regulations governing the operation and maintenance of such works or means and may require the submission of records and data of construction, operation and maintenance, including plans and descriptions of existing works or means of disposal of such sewage or wastes. When the state department of health shall require the submission of such records or information the public officials or person, firm or corporation having the works in charge shall promptly comply with such order.

Sec. 1240-3. The state department of health shall study and investigate the streams, lakes and other bodies of water of the state and waters forming the boundaries thereof, for the purpose of determining the uses of such waters, the causes contributing to their pollution and the effects of the same, and the practicability of preventing and correcting their pollution and of maintaining such streams, lakes and other bodies of water in such condition as to prevent damage to public health and welfare. For the purpose of providing effective control of the discharge of sewage and industrial wastes into the various streams, lakes and other bodies of water and for preventing the undue pollution thereof the state department of health many adopt and enforce such special or general regulation as it may deem necessary for the protection of the public health and welfare.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Italian Hydraulic Books Reach America

A set of works on hydraulic engineering, in Italian, which is of unusual importance, has been added to the Engineering Societies Library (29 West 39th St., New York City). The following information on the subject has been received from Harrison W. Craver, director of the library: "The 17 volumes that these series comprise were published in Bologna between 1821 and 1845. They contain, apparently, everything of importance on hydraulic engineering that had been written in Italian at that time. The first volume is a reprint of Domenico Guglielmini's "Della Natura de Fiumi," the greatest work of its day. Other volumes contain the writings of Galilei, Torricelli, Manfredi, Zanotti and many other physicists and engineers of note. For this valuable gift, which has great interest to hydraulic engineers, the library is deeply indebted to Comm. Ing. Prof. Gaudenio Fantoli of Milan. For several years, Professor Fantoli has been presenting interesting Italian publications on hydraulic engineering to the Engineering Societies Library, of which this is the most notable."

An Individualist on Structures

REVIEWED BY R. W. BOYD

Engineer, Turner Construction Co., New York City

ENGINEERING FAILURES AND THEIR LESSONS—By Edward Godfrey, Author of "Godfrey's Tables," "Steel Designing." Pittsburgh, Pa.: The Author. Cloth; 6 x 9 in.; pp. 279; line cuts. $3.

To the average engineer in search of light on how to design structures safely, with little time for acrimonious controversy, Mr. Godfrey's book will prove disappointing. Attracted by the title and interested in the table of contents—which covers practically all types of engineering structures from dams, arches and retaining walls, through steel and reinforced-concrete buildings, to bridges, tanks and pipe lines—the reader turns to the body of the book to find not an orderly array of engineering data presented in a logical manner leading to unescapable conclusions but rather a mass of controversial matter largely in the form of "What I said to him"—with the "what he said to me" not recorded.

Failures of dams of various types are discussed at some length. It is the author's opinion that one defect in design is responsible for almost all failures of dams, and that is lack of consideration of underpressure on foundations and horizontal joints. The reader, impressed by the soundness of the author's main thesis, would have welcomed an unimpassioned exposition of the entire subject with types that have failed serving as examples. Examples are there, with some explanatory matter, but the author's dogmatic statements and the uncompromising way in which his opinions are identified with absolute truth detract from rather than add to his argument.

In reinforced-concrete construction two design types, which appear to make the author see red, come in for scathing condemnation. The whole matter of failure of structural reinforced concrete is very simple. A beam or girder cracks or gives away; it is found to have been designed with stirrups as shear members; why look any further for causes of failure? A building collapses; it had "rodded columns"; what else could be expected? Anchored tension rods and hooped or spirally reinforced columns on the other hand are given high commendation. The flat slab as generally designed is looked upon with suspicion, in view of inadequate load tests and misleading mathematics in the determination of bending moments. The dry mix should never be used.

In discussing improper details and failures in structural steelwork the author is somewhat less bellicose, with the result that the matter presented is more readable. Many pitfalls in the form of improper structural details are pointed out. A misconception, however, of the function of a fascia girder in the discussion of a theater collapse casts considerable doubt on the value of the author's opinion in similar matters. Under the heading of bracing, the author calls attention to the need of lateral bracing for trusses, the top flanges of girders and for compression members generally. This chapter contains also a long statement of the author's opinion as to the cause of the first collapse of the Quebec bridge. This statement, first made public shortly after the disaster, attributes the collapse to the lack of bracing in the large traveler used for the erection of the cantilever arm.

The defects in the design of tanks, cement bins, standpipes, suspension-bridge cables and suspender rods, drawspans and bascule bridges are pointed out by the author. The weaknesses of concrete chimneys, retaining walls and pipe lines are also discussed, as well as defective details in derricks and other load-handling equipment.

Taken as a whole the book is not an easy one to read. The fact that much of the text consists of reprints of long letters written by the author at one time or another in presenting his views on various moot questions and consisting largely of unsupported statement, adds little to the authoritative value of the work.

To the unbiased mind, however, notwithstanding the truculent style of the book, its lack of logical presentation, and the superfluity of controversial matter, there is much of value to be found in it. The author's insistence that underpressure in dams must not be neglected is a timely warning. The persistence with which he has pointed out this defect has had no doubt a salutary effect on recent dam design. Although the author's views on stirrups and "rodded columns" are unquestionably extreme, the careful designer will do well to see that his stirrups are well anchored so that they will act as real tension members and to be sure that in column design where vertical rods are used without spiral hooping the ties are of sufficient size and are properly placed so as to prevent buckling in

the rods. Although somewhat irritating in the manner in which it is presented, the author's advice regarding bracing and the design of structural steelwork and of tanks and retaining walls is generally sound and if followed will doubtless result in fewer failures.

It is probably not too much to say that on the part of many engineers there will be genuine regret that the author's long experience in the field of structural engineering could not have been presented in a form that would have had wider appeal. With the ability for clear thinking which the author unquestionably possesses it would seem that in the preparation of this book there was presented an excellent opportunity for that kind of frank co-operation generally looked for on the part of engineers, but which the book withholds rather than gives. It seems a pity that the opportunity was missed.

Dangers of Prosperity

ECONOMICS OF BUSINESS CYCLES—By Arthur B. Adams, Ph.D., Dean of the School of Business and Professor of Economics, University of Oklahoma. New York and London: McGraw-Hill Book Co. Cloth; 6 x 8 in.; pp. 268; 10 charts $2.50.

SOCIAL CONSEQUENCES OF BUSINESS CYCLES—By Maurice Beck Hexter, Ph.D., Executive Director, Federated Jewish Charities of Boston, Instructor in Social Ethics, Harvard University. With an Introduction by Allyn A. Young. Boston and New York: Houghton Mifflin Co. Cloth; 6 x 8 in.; pp. 206; charts, appendix of data tables, index. $4.

That the low point in the curve of business cycles is due to prosperity is a major conclusion to be drawn from each of these well-wrought, thought-provoking books. Neither author has the temerity to suggest that prosperity, *per se*, be curbed. In fact, remedies are given minor consideration by Dean Adams and do not enter into Mr. Hexter's main plan at all.

Economics of Business Cycles was written "to supply the need for a text-book for college courses in Business Cycles" but the author hopes it will also "be of interest and value to business men, bankers and public officials." In plan and execution the book promises to serve both purposes. After a brief section on the business system and economic welfare and economic equilibrium, the author takes up first the nature and then a statistical description of business cycles, the latter including the trend of prices, bank and credit conditions, volume of production and of trade, wages, interest and profit. Prices and credit have a separate chapter. Prosperity, its initiation, cumulation and termination are next considered, then crisis, depression and recovery. The author next outlines and criticises a number of business cycle theories including those of Hansen, Foster and Catchings, Mitchell, in the self-generating credit theories class; Hobson's theory of business fluctuations in the unequal distribution class; and the physical force theories of Robertson and of Schumpeter.

The concluding chapter of Dean Adams' book, creditable as it is, and also such deductions as can be drawn from Mr. Hexter's analysis, show how far away we still are from remedies for industrial depressions; for both books point to prosperity as the begetter of industrial depressions—the sort of prosperity that gives high prices, high wages to employees and promises large profits to employers and investors, all of which lead in turn, Dean Adams' book says, to industrial and financial over-expansion and over-production, decreasing managerial and employee efficiency, contraction of credit, fall in prices, overstocks of goods, unemployment and closed shops and factories. The control measures discussed are mainly (1) changes in physical forces which initiate prosperity, of which the most hopeful one mentioned is "the more constant introduction of mechanical changes"; (2) attempts at controlling "cumulative prosperity" through better statistical information, forecasting, etc. As this section closes with a sub-topic on "fundamental weakness of private-control measures" one is forced to go forward to the author's consideration of "public methods of controlling cumulative prosperity," of which the chief, and the only one in which Dean Adams has much hope, is governmental control of bank credits in accordance with fluctuating business conditions.

Mr. Hexter's volume contains an advanced statistical and graphical analysis of cycles in business and in vital statistics, making use of coefficients of correlation for pairs of items in time series in order to judge the lag of one series in relation to the other. Unemployment and prices are used for the business side and vital statistics for the other, the latter including births, still-births, deaths, marriages and libels or applications for divorce, the latter in the county comprising the bulk of the population of Boston and all the other vital statistics being for Boston. Seasonal as well as cyclical fluctuations are considered. Mr. Hexter concludes that prosperity precedes and begets adverse business conditions, with an intermediate rise in marriage and birth rates, to mention but two of the kinds of statistics analyzed. Mr. Hexter's work deserves high commendation, although of limited appeal and only blazing and headlighting the trail for additional studies which may have more practical application to business and sociological amelioration.

The Case for Public Ownership

PUBLIC OWNERSHIP: A Survey of Public Enterprises, Municipal, State and Federal, in the United States and Elsewhere—By Carl D. Thompson, M. A., Secretary of the Public Ownership League of America. New York: Thomas Y. Crowell Co. Cloth; 6 x 8 in.; pp. 445; 23 halftones, data tables, index. $3, postage extra.

Years of work in gathering and digesting information on the extent and results of public ownership in this and other countries are here summarized by the secretary of the Public Ownership League of America. The survey also includes numerous governmental services not involving public ownership, as that term is generally understood, reviewed to show the extent to which goverments engage in business and the successful results obtained, as the author sees it. Although the Preface states that the volume is confined to "facts" these are so chosen and interpreted as to make the book one of propaganda. Like most propagandists the author weakens his case by excess of zeal, shown in lack of discrimination in the acceptance and interpretation of "facts." He also uses material sometimes so old that the conditions it represents may have been materially changed by now.

The book opens with chapters on Familiar Forms of Public Ownership and The Government in Business, the latter including various things done to promote agriculture, social welfare and the protection of life. Then follow reviews of various federal, state and municipal enterprises, in most of which public ownership is a feature. These include railways, the telegraph and telephones, mines, banks, insurance, elevators and mills, printing plants, water-works and the other utilities. A miscellany of municipal enterprises is taken up in a single chapter, ranging from sewers and the fire depart-

ment to abbatoirs, the milk supply and funeral management. The Ontario hydro-electric enterprise is given some scores of pages in which the controversies which have waged over this Canadian venture in public ownership are summarized with an abundance of statistical evidence, all favorable to the project or at least so interpreted by the author. The book closes with a lengthy chapter, Objections to Government Ownership Considered, which is in part a convenient summary of what has preceded.

The book will be welcomed by most of the advocates of public ownership as a valuable contribution to their cause, although some will wish the author had not laid himself open to so much criticism for partisanship. It is likely to mislead the uninformed and undiscriminating. It does not promise to convert many who by reasoning, tradition, commercial interest or association believe in private rather than public enterprise—but perhaps even the author's unbounded optimism does not carry him so far as to expect converts from the opposition.

New Edition of an Old Friend

FIELD ENGINEERING: A Handbook of the Theory and Practice of Railway Surveying, Location and Construction—By William H. Searles, C. E., Late Member Am. Soc. C. E. Nineteenth Edition, Revised and Enlarged—By Howard Chapin Ives, C. E., Professor of Railroad Engineering, Worcester Polytechnic Institute. Volume I, Text; Volume II, Tables. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Flexible; 4 x 7 in.; pp. 348; 152 drawings; tables. Complete, Vol. I and Vol. II (Text and Tables) $4. Bound separately, Vol. I, text, and Vol. II, tables, $2.50 each.

Due to the many changes made in the 17th and 18th editions as well as to the changes which made a new edition desirable, the 19th edition has been entirely reset and somewhat rearranged, and, although considerable new material has been included, the book has been maintained in about its former convenient size through the omission of certain sections.

For 46 years this book on the theory and practice of railway surveying, location and construction has been in such general use throughout the country that it is unnecessary to go into any details as to its contents. With two other books of similar character it has become a recognized authority on railway engineering work and it suffices to say that the 19th edition contains practically all the material of the previous editions, arranged in a somewhat different form, with additions to improve the presentation in some cases and to continue the policy of keeping the book up to date by frequent revisions.

Aids for Inexperienced Map Makers

TOPOGRAPHIC MAPPING—By Major L. B. Roberts. Washington, D. C.: The Society of American Military Engineers. Flexible binding; 4x7 in.; pp. 142; many halftones and line drawings. $1.50.

Major Roberts believes that ground work is still necessary in the preparation of accurate topographic maps despite the advances in the art of aerial surveying. Believing this, he has set down in concise form those things that a map maker learns not from books but from long experience in the field, experience which in Major Roberts' case was gained by years of service in the topographical surveys of the U. S. Geological Survey and in the preparation of maps for the A. E. F. in France.

The opening chapters of his book deal with the instruments used in map making, chiefly the plane table. This is followed by a discussion of the methods of showing relief on maps and then chapters on the general subject of mapping and on topographic ground forms, showing by illustration those features of terrain which the experienced topographer learns to recognize and work into his map without difficulty, but which cause frequent trouble for the novice. The last chapter discusses aerial photography as related to topographic mapping, and outlines briefly the major points in this relatively new method of preparing maps.

Johnson's Materials Revised

JOHNSON'S MATERIALS OF CONSTRUCTION—Rewritten by M. O. Withey, Professor of Mechanics in the University of Wisconsin, and James Aston, Metallurgist with the A. M. Byers Co. of Pittsburgh; Edited by F. E. Turneaure, Dean of the College of Engineering of the University of Wisconsin. Sixth Edition. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 865; line cuts and halftones. $6.

J. B. Johnson was a real pioneer in the literature of materials and of testing. Nearly thirty years ago his monumental work was written, to become the valued textbook for thousands of present-day engineers and the model for numerous successors. Fortunately for the revisers the science of materials does not rapidly change. New things are discovered, to be sure, and new methods of testing developed, but the fundamental composition and quality of material remains, and its science is much more stable than in those subjects where theory is more governing. The revisers have, however, recognized that some changes do take place and some new things are learned and so from time to time they go over the old authority and bring it to date. The edition noted above is the latest of such revisions, which keeps young and vigorous one of the seniors of engineering literature.

Second Issue of Municipal Annual

MUNICIPAL INDEX, 1925—A Yearbook for City, Town and County Officials, etc. Second Annual Edition. New York: The American City Magazine. Cloth; 8 x 10 in.; pp. 521, including advertisements. $4.

Water Supply Statistics for cities of the United States of 5,000 population or more is the outstanding new feature of the second issue of this comprehensive annual. Of other statistical sections the most extensive is one on lighting, besides which there is a section on municipal power plants. All the principal and some of the minor fields of municipal activity are reviewed, some at length, others briefly; in a number of cases by special contributors. Among the leading sections not yet mentioned are: Administration and Finance; City and Regional Planning, Housing and Zoning; Garbage, etc.; Motor Trucks; Parks, etc.; Public Health; Sewers and Sewage Disposal; Street Cleaning and Snow Removal; Street Construction. The topical sections of reading matter are followed by advertisements in the same field.

Linking Atlantic and Pacific By Rail

EPIC OF THE OVERLAND—By Robert Lardin Fulton. With Sketch of the Life of the Author by Dr. H. W. Hill. San Francisco: A. M. Robertson. Pp. 109; illus. $2.50.

The author of this interesting book of personal reminiscences was closely connected with the work that culminated in the joining of the Central and Union Pacific lines at Promontory Summit, on May 10, 1869. Work on the Central Pacific line began in 1863 at Sacramento, Calif. The Union Pacific started construction in 1865. The story is punctuated with interesting inci-

dent. A telegraph line was used, which speeded construction, but the buffaloes broke down the poles. Sharp shoemaker awls were then driven in these a few feet from the ground. The story of this great achievement in railroad building, spiced with the varied incidents of the times and marked with the imprint of many a strong personality, forms a vivid chapter in the history of Western development.

PUBLICATIONS RECEIVED

DEFINITIONS for Sewerage and Sewage Disposal Practice, by the Committee on Sewerage and Sewage Disposal, Sanitary Engineering Section, A.P.H.A., fill 9 pp. of the *American Journal of Public Health* for April. These definitions are followed by a page on Public Health Nomenclature, giving 18 definitions pertinent to that subject. (New York: American Public Health Association, 370 Broadway; 50c. for single copies of *Journal*.)

CITY MANAGER INFORMATION of the kind formerly issued as a year book appears in the March issue of the *City Manager Magazine* (Lawrence, Kan.; $1 a copy). The issue contains a Directory of City Manager Cities and Their City Managers, revised to March 10, 1925, besides the Proceedings of the 1924 conference and much other material. Including 19 manager cities in Canada and three in New Zealand, 353 city manager cities are listed.

DETAILED METHODS of the manner in which longitude determinations may be made by wireless are contained in a 52-p. illustrated bulletin prepared by experts in the U. S. Geodetic Survey and the U. S. Bureau of Standards and published by the former. Not only are the methods for longitude determination fully explained, but the volume contains all complementary data: kind and use of instruments, selection of sites and astral objects, computations necessary, etc. Also, there are a number of theoretical discussions of radio operation which the layman may find valuable. The volume is well illustrated. (15c. from Superintendent of Documents, Washington, D. C.)

AT LAST, we have in this country a periodical devoted entirely to city planning. The first issue of this new quarterly is dated April, 1925, and the title is *City Planning* and the subtitle, Official Organ of the American City Planning Institute, the National Conference on City Planning. It is edited by Henry V. Hubbard, professor of landscape architecture in Harvard University and has a goodly staff of contributing editors. A feature of this first number is the annual city planning survey made by Theodora Kimball Hubbard, which this year has the broadened title, Survey of City and Regional Planning in the United States, 1924. There are greetings by President-Emeritus Eliot, Secretary Herbert Hoover, and Ebenezer Howard, "Father of the Garden City." Among the brief articles mention may be made of one by Thomas Adams on Ideals of the New York Regional Plans; Park Scenery for City Dwellers, by F. L. Olmsted, Sr.; and Interest of the Engineer in City Planning by M. N. Baker. Departments that are apparently designed to be carried in each issue are Legal Notes, Current Progress, Zoning Round Table, Institute News, and Book List and Book Reviews. (Boston, Mass.; City Planning Publishing Co., 9 Park St.; 75c. a copy or $3 a year; foreign, $1 and $3.50.)

THE CENTENNIAL CELEBRATION of the Rensselaer Polytechnic Institute at Troy, N. Y., last October, is the subject of a handsome illustrated book just published by that institution. The volume includes text and illustrations of the pageant of that date.

FURTHER STUDIES by the State Water Survey of Illinois make a 59-p. bulletin. The topics are Comparison of Chemical and Bacteriological Examinations Made on the Illinois River During a Season of Low and a Season of High Water, 1923-24, by R. E. Greenfield, and some notes on Sources of Pollution of the Streams of Illinois, by G. A. Weinhold, Mr. Greenfield and Director A. M. Buswell. (10c. fer postage, from State Water Survey, Springfield, Ill.; also, for 3c. postage, a Bibliography of Solubility and Rate of Solution of Gases.)

A VARIETY OF HIGHWAY STATISTICS, by states, has been compiled by Andrew P. Anderson, highway engineer, Bureau of Public Roads under the title, Rural Highway Mileage, Income, and Expenditures, 1921 and 1922. (15c. from Superintendent of Documents, Washington, D. C.)

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

BITUMINOUS SUBSTANCES: Scientific Progress of Practical Importance During the Last Fifteen Years—By Percy Edwin Spielmann, Ph.D., (Bâle), B. Sc. (London), F. I. C., Late Head of the Technical Section and Laboratory of Messrs. Highways Construction, Ltd., Co-opted Member of the Bitumen Sub-Committee of the Standardization Committee of the Institution of Petroleum Technologists. With a Foreword by J. Kewley, Member of the Council of the Institute of Petroleum Technologists. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 206; frontispiece halftone, 44 line cuts; bibliography. $4.50.

ELEMENTS OF BUSINESS STATISTICS—By Robert Riegel, Ph.D., Professor of Insurance and Statistics in the Wharton School of Finance and Commerce, University of Pennsylvania. New York and London: D. Appleton & Co. Cloth; 6x8 in.; pp. 549; 124 graphical diagrams, tables of logarithms, index. $4.

GRUNDLAGEN DES INGENIEURHOLZBAUS — Von Hugo Seitz, Regierungsbaumeister in Stuttgart. Berlin: Julius Springer. Paper; 7x10 in.; pp. 20; 48 line cuts. Paper, 5.7 marks, cloth, 6.9 marks, gold, in Germany.

JOHN EDSON SWEET: A Story of Achievement in Engineering and of Influence Upon Men—By Albert W. Smith, Dean Emeritus, Sibley College of Mechanical Engineering, Cornell University. New York: The American Society of Mechanical Engineers. Cloth; 6x9 in.; pp. 220; frontispiece and 14 illustrations.

NEUE TABELLEN FÜR EXZENTRISCH GEDRÜCKTE EISENBETONQUERSCHNITTE—Von Dr.-Ing. W. Kunze, A. O. Professor an der Technischen Hochschule, Dresden. Berlin: Julius Springer. Paper; 6x9 in.; pp. 16.

THE PUBLIC AND ITS UTILITIES—By William G. Raymond, C. E., LL.D., Eng. D., Professor of Engineering and Dean of College of Applied Science in the State University of Iowa. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 346; appendix of operating expense tables, and amortization tables. $3.50.

PUBLIC FINANCE—By Harley Leist Lutz, Ph. D., Professor of Economics in Leland Stanford, Jr., University; Author of "The State Tax Commission"; Co-author of "An Introduction to Economics." New York and London: D. Appleton & Co. Cloth; 6x8 in.; pp. 681. $4.

REINFORCED CONCRETE BRIDGES: The Practical Design of Modern Reinforced Concrete Bridges, Including Notes on Temperature and Shrinkage Effects—By W. L. Scott, Assoc. M. Inst. C. E., Chief Engineer, Considère Constructions, Ltd.; Assisted by C. W. J. Spicer. London: Crosby Lockwood & Son. Cloth; 6x10 in.; pp. 207; 24 halftone plates, 126 line cuts. 42s.

THE SEASONING AND PRESERVATION OF TIMBER: Being a Treatise on the Various Methods Employed for Drying and Preserving Timber Against Decay; With a Chapter on The Origin and Spread of Dry Rot, and the Best Method to be Adopted for Its Eradication—By Ernest G. Blake, M. R. S. L., A. B. I. C. C., Medallist in Sanitary Building Construction, etc.; Author of "Building Repairs," "Damp Walls," "Plumbing," etc. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 132; 38 halftones and line sketches. $2.50.

SEWAGE DISPOSAL IN INDIA AND THE EAST: A Manual of the Latest Practice Applied to Tropical Conditions—By George Bransby Williams, Vice-President of the Institution of Engineers (India); M. Inst. C. E., etc., Chief Engineer, Public Health Department of the Government of Bengal. New York: D. Van Nostrand Co.; Calcutta and Simla: Thacker, Spink & Co. Cloth; 6x9 in.; pp. 230; 37 line drawings and plates and halftones; 12 data tables. $4.

STATISTICAL METHOD—By Harry Jerome, Assistant Professor of Economics, University of Wisconsin. New York and London: Harper & Brothers. Cloth; 6x9 in.; pp. 395; 41 charts, 69 plates; 15 appendix tables, tables of logarithms, lists of symbols and formulas; index. $4.

TAXATION AND WELFARE—By Harvey Whitefield Peck, Ph. D., Associate Professor of Economics in the University of Vermont. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 269; 3 graphical charts. $2.50.

VORLESUNGEN ÜBER WASSERKRAFTMASCHINEN — Von Dr. Phil. Dr.-Ing. R. Camerer, Dipl.-Ing., O. Professor des Maschinenbaues an der Technischen Hochschule in München. Zweite, Neubearbeitete Auflage von Dipl.-Ing. Bernhard Esterer. Leipzig: Wilhelm Engelmann. Coth; 8x11 in.; pp. 515; 646 halftones and line cuts in text, 42 plates. 28 marks, gold, in Germany.

The first edition of this book was reviewed by H. E. Longwell in *Engineering News*, Dec. 19, 1914, who characterized it as a high-grade and well-written textbook. In the general overhauling of the present edition the text has been condensed by some ten per cent and the number of plates reduced.

THE WATER SUPPLY OF BUILDINGS AND RURAL COMMUNITIES: For Engineers, Architects, Plumbers and Property Owners—By Walter S. L. Cleverdon, M. Am. Soc. C. E., Associate Professor of Sanitary Engineering, New York University; Formerly Assistant Engineer, Department of Water Supply, Gas and Electricity, and Board of Water Supply, New York City. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 186; 59 halftones, line cutes and plates; Appendix of 23 charts and tables. $2.50.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Early Underground Sewage-Works

Sir—In view of the article on "Compact Underground Sewage-Works in Lower New York," in your issue of April 9, 1925, p. 611, permit me to call your attention to a report made by Tribus & Massa to the Merchants' Association of New York City, outlining a general plan for underground sewage screens and settling tanks to be placed in cross or marginal streets. The report was printed, with a typical plan, in *Engineering News*, March 4, 1909, p. 255. This gave the cue from which New York municipal engineers worked out the Canal St. project.

New York City, April 13, 1925.

LOUIS L. TRIBUS, Consulting Engineer.

An Engineer Decries Educational Methods

Sir—1. A western school professor, a recent engineering graduate, once asked me (then an irrigation engineer), in all seriousness: "Between irrigations, why not use your ditches as seepage drainage ditches, and save duplicate construction expense?" (And good grades were common with him in college.)

2. I crossed a machinery opening 80 ft. deep on a 12x12-in. fir timber, 6-ft. span. An assistant (a graduate of a well-known eastern university) loyally took me to task for my recklessness with: "How did you know it'd hold you up."

3. A combined outlet sewer figured out as requiring an area of 6 ft. x 6 ft. Later, it developed that more advantage would be had from two outlets, in different places. The college-bred engineer built them each 3 ft. x 3 ft. He had received good grades in mathematics, too.

4. An eastern university graduate inspector, taken to task for allowing steel, badly lined, to be concreted in, defended himself with: "What difference does it make as long as the steel doesn't touch the form."

And so on ad absurdum. Any engineer can add to the list if he knows much of recent graduates.

Why such errors in fundamentals? simple errors of common sense? One might argue lack of experience, heedlessness, carelessness of speech due to a temporary aberration, etc. But aren't our engineering schools to blame some too? Isn't some of it a "hangover" from the mental indigestion the average student staggers under. Granted Fletcherized instruction is impossible with the crowded courses, cannot something be done toward that end. How many instructors and assistant professors (and even associate professors) have had any practical work? Would the average teacher of those ranks ordinarily make good in doing the things he teaches? Then will not that class of instruction be deficient? And isn't that the very basis of the common criticism one hears: "He seems to be able to write good examination papers, but he doesn't seem to develop in actual work."

Bernard Shaw's aphorism: "Those who can, do; those who cannot, teach," is, of course, very harsh. But if he had been referring to engineering teachers in general one could easily imagine this pessimism had been voiced after some practical man had put an inexperienced engineering instructor in charge of work; that he later found his engineer had "fallen down" in his estimates, in handling his man-problem and, in general, in "getting punch into the job."

There seems much merit in the idea of engineering teachers and engineers exchanging jobs occasionally—assuming the engineer has ability to impart instruction. We have too many teachers, lately out of school; and too many old teachers with no recent practical experience. Shall we say engineering school instruction is suffering from adolescence and obsolescence? It is not an accident that scholarship scores as high and higher, and that executive ability "to do the job" scores higher, among recent graduates from West Point and Annapolis than from civilian schools. Except for some language and mathematical courses, instruction from those schools comes from men fresh from doing the thing being taught. Such instruction (in the language of smallpox vaccination) "gives a take." And that instruction is paid for at a standard pay of rank, too—no reduction because in a school job. Let's have a nearer approach to the detail system "from among engineers in our engineering schools."

R. Z. KIRKPATRICK.

Balboa Heights, Canal Zone.
March 23, 1925.

Grassed Shoulders on French Roads

Sir—Apropos of your comment in *Engineering News-Record*, April 2, 1925, p. 545, on experiments with grass covered road shoulders, the enclosed view of a French highway used by the A.E.F. may be of interest.

Grass covered raised shoulders forming a low curb adjacent to the road metal have been for many years an integral part of French design. Narrow lateral ditches at frequent intervals provide for drainage into the main longitudinal ditches outside the shoulders. The shoulders prevent traffic from leaving the road metal and breaking down the edges.

GRASS SHOULDERS ON FRENCH HIGHWAY

HENRY WELLES DURHAM.

Sandwich, Mass.,
April 9, 1925.

What's in a Name?

Sir—In its quest for recognition of the engineer on a par with members of the clergy, the legal, and the medical professions, we think there is one factor which the engineering profession has overlooked—and that is an important psychological factor.

Whether we like to believe it or not, the American people are fond of titles. Before a man becomes a senator, for example, he may be recognized for no great ability, nor command any great measure of respect; but let him once be elected and called "Senator," and his title is forever afterward "Senator." The title carries with it a certain amount of prestige not accorded the layman or engineer. In the same way, let a lawyer comparatively unknown, and perhaps of small ability, be elected to some position as judge, and thereafter, even after he has left the office, he retains his title of "Judge Y." The doctor gains a certain prestige through his professional title as "Doctor Z," and the layman must needs accord a certain degree of deference to "the Reverend A" that the engineer, himself a layman, does not receive. So likewise "Captain Doe" and "Professor J" receive their dole of special recognition from the public through the title which they bear.

How about the engineer? Is it "Engineer So and So"? Or has he a pet name or title of some kind that endears him to the title-loving public? It is not so. Even his legitimate name of engineer goes to crown the head of the "Hymn-book Engineer" or the "Shoe-shining Engineer" long since commented on in "Random Lines."

Now it would seem that the engineer is doing something

that the public admires, else it would not be so desirous of stealing his legitimate name and bestowing it upon the "Clothes-designing" and other "would-be" engineers. We think the engineer may contrive to capitalize this admiration in some way and perhaps "come into his own" if perchance he is able to coin some catchy name which he will receive and always retain after he has filled some public office, or completed some notable engineering work, or done some other act that has particularly interested the public. The name should carry with it the same professional dignity as does the term judge for the lawyer, reverend for the preacher, doctor for the physician, or captain for the soldier. Who'll coin the engineer's psychological title that will win him this public recognition he so craves?

We have known of men bearing the Ph.D. degree posing before the druggist as "M.D.," thereby receiving the physician's discount on drugs purchased for personal use. Why do not the engineers wake up to the psychology of the situation?

JUST AN ENGINEER.

April 10, 1925.

Record Flint River Flood Takes Out Steel Highway Bridge

Sir—On Jan. 12, 1925, the Flint River at Bainbridge, Ga., started rising and on Jan. 24 had reached a stage never before attained in this vicinity. The water rose from a normal elevation of 65 to El. 99.6. On March 11 it was still at El. 72.

FLINT RIVER AT BAINBRIDGE, GEORGIA, BEFORE AND AT CREST OF RECORD FLOOD

The Hardaway Contracting Co. is building a reinforced-concrete bridge across the river here and the writer who is located with this company had occasion to witness this flood carefully and believes that it may be of interest to other engineers.

The maximum stage of the river was the highest ever witnessed and caught unawares many people and industries, forcing abandonment of property before anything could be saved.

The upper illustration shows the river at its normal stage, and the lower shows the water at its highest elevation. The steel highway bridge was washed away and traffic on both the G. F. & A. and A. C. L. railroads was stopped for approximately a week until fills could be replaced and new track laid.

The highway bridge at Bainbridge was completely covered by water above the hand rail before it went out. This structure was built in 1840. The draw span remained for days after the bridge had gone but as the water receded it moved off its center pivot and fell into the river. The cause of the main bridge going out was later found to be due to the fact that cylindrical piers on the west bank had been undermined.

In one month after the washout the Hardaway Contracting Co. had built a timber bridge, salvaged the draw out of 30 ft. of water and traffic was resumed.

FREDERICK C. RAY,
with Hardaway Contracting Co.

Bainbridge, Ga.,
March 11, 1925.

Data on Bridge Service

Sir—In the editorial on p. 546 of your issue of April 2, entitled "A Contribution to Bridge Development," you say, in part, "If riveted bridges of long span show definite superiority in service, it can hardly be doubted that they will continue to grow in favor, to the point of rendering pin-connection obsolete. But on this point of service value few tangible data exist and it is much to be desired that specific experience records be brought together as soon as feasible to clear up the question."

I wish to endorse this suggestion heartily; it should, however, not be limited to long spans.

As a part of the government's conservancy service or as a subject of engineering research, I believe an investigation would yield rich results. Pin-connected bridges were removed more because of the rapid increase in loading than from inherent defects. Riveted construction replaced them and has become very general through what may be shown to be somewhat of a fetish when all the facts are studied.

It does not follow, necessarily, that whatever is is right. We have seen universal practices in bridge building found to be wrong, for example, the custom of using mortise-and-tenon joints in trestles and the prohibition of closed sections in metal structures by the specification that "all sections shall be open for inspection and painting" when experience shows that the interior of the closed section does not corrode and does not require inspection and painting. Thus, the strongest, most economical, most sightly section has been prohibited for generations.

Let us get the facts and then judge. This is an economic question.

GEORGE H. PEGRAM,
Chief Engineer, Interborough Rapid Transit Co.

New York,
April 11, 1925.

Round-Corner Windows

Sir—We notice in your issue of March 26, p. 530, that you describe a round-corner window sash which has been adopted for the new Tribune Tower Building, Chicago. We wish to state that Holmes Onderdonk, manager of the building, gave us the idea for this innovation.

JAMES M. HOWELLS, RAYMOND M. HOOD,
Associated-Architects.
Per J. ANDRE FOUILHOUX.

Chicago, Ill.,
April 13, 1925.

Proper Form of Unsymmetrical Arch

Sir—In reply to the inquiry from your correspondent published on p. 527 of the issue of March 26, requesting information as to the correct shape for an unsymmetrical arch, I wish to call his attention to the fact that Winkler's theorem that the true line of pressure is that one lying nearest the arch axis is applicable to either symmetrical or unsymmetrical arches and to any condition of loading. If, then, he will estimate the intensity of dead-load, or of dead-load plus one-half live-load, along the arch and will pass an equilibrium polygon for these loads through the two springing points with a rise equal to the given rise, this will closely approximate the correct shape for the arch axis. Revision of the computed loads and of the equilibrium polygon may then be made.

HARDY CROSS,
Professor of Structural Engineering,
University of Illinois.

Urbana, Ill.,
April 1, 1925.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Civil Engineers Board Busy With Administrative Questions

Editorial Correspondence

Detail questions of society administration occupied most of the time of the Board of Direction of the American Society of Civil Engineers at its meeting in Cincinnati, April 20 and 21. Several interesting matters of general importance were dealt with, however, including unprofessional conduct, the relation of the society to Engineering Foundation, American Engineering Standards Committee and Engineering Council, city planning for District of Columbia and special encouragement of local and student chapters.

Several cases of alleged unprofessional conduct brought to attention of the board were considered. They are to be reviewed further at the next meeting. Proposals for changes in by-laws of United Engineering Society relating to scope of Engineering Foundation activities were left to be dealt with by President Ridgway in further conference. Admission of American Mining Congress to Standards Committee was approved and the board accepted for the society joint sponsorship with the telephone group for standards for manhole frames and covers. W. W. Brush and R. B. Morse will represent the society on this sectional committee. C. M. Spofford will act on a newly formed section committee on scientific abbreviations and symbols.

A new phase of the Federation question was brought up by request of the Washington section for authorization to join Engineering Council. The board declined to give such authorization holding that as the society has more than once decided not to affiliate with Council it does not seem advisable for a local section to affiliate. With a view to bringing about creation of a city planning commission for the District of Columbia, a number of Washington members requested the board to aid the movement through a committee of wide geographical representation but the board decided upon appointment of a small committee to study and recommend action. In order to stimulate student chapter activities the board passed a resolution recommending that each local section take special interest in nearby chapters and encourage their technical development by arranging competitions in technical papers with junior memberships in society as prizes.

Three student chapters were chartered, at Cooper Union, University of Wyoming, and University of Akron.

George T. Seabury was re-elected secretary, and Otis E. Hovey, treasurer. W. J. Boucher was elected assistant treasurer, a position not heretofore filled.

On April 21 the annual conference of local sections, which met in two sessions, was occupied mainly with discussion of section activities and methods but to some extent also with affairs of society. These discussions were of a thoroughly harmonious character devoid of opposition between local and national ideas. A single reminder of the former period was the motion of Washington delegate Avery to have four conferences and provide self determination. This was tabled by a vote of 19 to 5. In general discussion ample evidence was brought forward of the extensive influence which local sections can exercise in civic and governmental affairs in their communities.

Engineering Fifty Years Ago

From *Engineering News*, April, 1875

THE first issue of the Baltimore "American" August 20th, 1772, contained an advertisement from George Washington, Engineer, offering for sale a tract of land bordering on the Ohio and Great Kanawha Rivers.

R. J. Durley Becomes Secretary of Canadian Institute

Richard John Durley has been appointed secretary of the Engineering Institute of Canada to succeed Fraser S. Keith, who resigned in December to become manager of the Department of Development of the Shawinigan Water & Power Co. Mr. Keith has been secretary of the Institute for the past eight years. He will remain as secretary of the council of the institute in an advisory capacity.

Mr. Durley is a native of England and a graduate of University College, Bristol, and University College, London. After serving for some time as a mechanical engineer with the Earle Shipbuilding & Engineering Co., he took charge of the mechanical engineering department of the newly formed Hull Municipal Technical School. In 1898 he came to McGill University, Montreal, and in 1901 succeeded the late Dr. J. T. Nicolson as professor of mechanical engineering. From 1911 to 1915 Mr. Durley was in private practice in Montreal. During the War he served as officer in charge of the Division of Gages and Standards, Imperial Ministry of Munitions, Inspection Department, Canada. In 1919 he was appointed secretary of the Canadian Engineering Standards Association. Mr. Durley is a member of the Engineering Institute of Canada, the Institution of Civil Engineers of Great Britain, and the American Society of Mechanical Engineers.

Supreme Court Upholds Open Shop Fight in Calif.

Finds No Violation of Sherman Anti-Trust Law in Restrictions on Builders Supplies

In a decision on April 13 by Justice Sutherland, concurred in by the whole court, the United States Supreme Court declared that the operation of the so-called "American plan" in building operations in the State of California was not in violation of the so-called Sherman Act. The decision overruled the decision of the United States District Court for the Northern District of California, which had declared that these operations were in restraint of interstate trade.

As a part of the "American plan" there was instituted in California an open shop in building operations, mainly in the city of San Francisco, to enforce which an organization of contractors and building supply dealers was formed, with requirements that no building supplies made in the State of California should be sold to any contractor who did not comply with the open-shop provisions of the American plan. In order to avoid interference with interstate commerce such kinds of equipment and material as are manufactured outside the state were excluded from the provisions of the agreement, but in a suit brought against the organization in the California District Court it was developed that in a few cases some material from without the state had been brought under the operations of the agreement. The Supreme Court, however, in investigating the case finds that "the aggregate value of the materials involved in these few and widely separated instances was at the utmost a few thousand dollars, compared with the estimated expenditures of $100,000,000 in construction of buildings in San Francisco during the same time." It was therefore ruled that the violation, if any, was so small that it could not rightly be construed as restraint of trade, and that "To extend a statute intended to reach and suppress real interference with the free flow of commerce among the states, to a situation so equivocal and so lacking in substance, would be to cast doubt upon the serious purpose with which it was framed."

Engineering Educators to Meet at Union College

Announcement has been made that the next meeting of the Society for the Promotion of Engineering Education will be held June 17-20, 1925, at Union College, Schenectady, N. Y. Full details of the program have not yet been prepared. The secretary is F. L. Bishop, Dean, College of Engineering, University of Pittsburgh, Pittsburgh, Pa.

WASHINGTON NOTES

Before advertising for bids for the temporary use of Muscle Shoals power, the War Department has referred the proposition to the Muscle Shoals Commission for a recommendation. In doing so, however, attention was called to the fact that Secretary Weeks had given notice in November, before the convening of the last session of Congress, that he would make temporary disposition of the power if Congress did not take action. Reasons why the power should be sold pending action by Congress were communicated to the commission. A very generally held opinion is that the administration would subject itself to severe criticism were it to withhold the power when it is badly needed throughout a wide area, and when it can be sold readily for a large sum.

The acting Secretary of War has called to the attention of the Commission the fact that the forthcoming summer and fall promises to be a period of unusually low water. He also pointed out that careful and extensive tests of machinery and equipment must be made before the War Department can accept this property from the manufacturers. These tests must be made under load.

The wisdom of having leased the steam plant is apparent, since it has brought in nearly half a million dollars in revenue. Had it not been leased during the past three and one-half years it would have called for considerable expenditures for its maintenance in standby.

There is no thought of making a firm contract for any power. The lease will be revokable at the will of the War Department. Another condition provides for the automatic termination of the lease if Congress should take action which conflicts with such use of the power. In no case is the proposed lease to extend beyond December 31, 1926.

The lessee of the power also is required to sell as much as 25,000 hp. to the lessee of the nitrate plant. The sale is to be made at cost, plus ten per cent. One of the questions put to the commission is whether or not the War Department should issue "a revokable lease of the steam power plant combined with the sale of power from the first hydro-electric unit, with the idea of making power available for the partial operation of plant No. 2," or merely sell the surplus power under a revokable contract only.

The Muscle Shoals Commission also has been asked by the War Department whether it is practicable to lease nitrate plant No. 2 for partial operation.

While it is hard to understand how anyone could undertake the fixation of nitrogen on a month-to-month basis, it is the announced intention of the Union Carbide Co. to bid for the power and the use of the nitrate plant.

The War Department will insist that the power be leased to one bidder. For several months variable amounts of power will be available. If there is more than one bidder it would raise difficulty in deciding which one should be deprived of power when the full output is not being delivered

Tower 705 Ft. High Proposed for New Terminal at Cleveland

Changes in the plans of the Cleveland Union Terminal Co. for their joint railroad and rapid-transit terminal on the Public Square at Cleveland, Ohio, call for a monumental tower 705 ft. high surmounting the group of terminal buildings. Earlier plans, published in 1921 (*Engineering News-Record*, Sept. 22, 1921, p. 1020), called for a low terminal structure more on the type of the Pennsylvania Station in New York City, adjoining the Hotel Cleveland, already built at the southwest corner of the square. A model of the proposed group of buildings is shown in the accompanying illustration. The Hotel Cleveland is the building at the right. The other buildings will be of similar design and material. Foundation for the tower will be carried to rock at a depth of about 200 ft. below street level.

705-FT. TOWER FOR CLEVELAND UNION TERMINAL

Work on the 35-acre terminal site adjoining the public square is well under way. Most of the old buildings have been removed from this area as well as from the right-of-way for the approaches. A large amount of excavation has been done and concreting on the 50-ft. retaining wall along the east side of the site has been started. This wall is built on clay on spread footings. On the west approach the 300-ft. reinforced-concrete undercrossing west of 25th St. is practically completed.

All tracks entering the terminal will be electrified, the electric operation to extend to convenient points outside the city.

Cleveland Trade School Graduates 150 Apprentices

Classes in plumbing, bricklaying and carpentry, numbering 150 apprentices, were graduated from the Cleveland Building Trades School on April 10. Early in January classes in painting and electrical work were started and at the present time there are approximately 1,000 apprentices in the five trades attending the part-time school.

The apprentice classes operate under the Smith-Hughes law, which is a federal act that provides for federal aid in the support of part-time trade schools. The balance of the money required to carry on the school is furnished by the local Board of Education and building material is supplied by local manufacturers and dealers. Each apprentice class is under the direct supervision of a joint committee made up of contractors, union representatives, and the local Board of Education. Every candidate, after passing an examination as to his mental and physical fitness, is indentured to a contractor in his chosen trade and admitted to the part-time school. The apprentice then begins a four-year training program in which the theoretical part of his trade is co-related with the practical in such a way that when he completes his course he is a much better mechanic than he would have been had he learned his trade under the old apprenticeship system.

Each apprentice is required to spend 4 hours per week in school during his entire apprenticeship period, for which he is paid by his employer. In the event an employer finds it impossible to keep an apprentice steadily employed, the boy is transferred temporarily to another employer.

Owensboro Railway Not Yet Acted Upon by the Commission

The Interstate Commerce Commission has not yet acted upon the application of the Owensboro, Rockport & Chicago Ry. for a further hearing on its petition for a certificate of public convenience and necessity to build an electric railway from Owensboro, Ky., to Elnora, Ind., including a bridge across the Ohio River. The renewed application was filed following a report, during the latter part of the year 1924, by the attorney examiner and the engineer examiner for the commission, recommending that the application be denied.

A recent report from Terre Haute, Ind., states that a contract of approximately $7,000,000 has been let for the construction of this railway. But the accuracy of this report is doubted in view of the fact that the commission has not authorized the construction of the railway.

New Power Plant on Mississippi

Plans for a power development on the Mississippi River at Rice, 15 miles north of St. Cloud, Minn., have been announced by the Minnesota Power & Light Co. The new plant is to have a capacity of about 16,500 hp. and is estimated to cost about $2,000,000.

Four Bids for Sewage-Works at Trenton, N. J.

As a result of its third call for bids for building a 30-m.g.d. sewage works, completed, the city of Trenton, N. J., on April 10, received four proposals, of which three were well below the estimated cost of $1,084,899 made by the consulting engineers—George A. Johnson and George L. Watson, New York City—and one was at 100 per cent the estimate. The bidders and percentages were: J. P. White Co., Passaic, N. J., 91.5; McLean Contracting Co., Baltimore, Md., 92.74; M. Staub-Kolyn Construction Co., Trenton, N. J., 95.88; Joseph L. Sigretto, Bernardsville, N. J., 100. The works will consist of an overflow chamber, inlet conduit, gate house, grit chamber, pumping station and equipment complete, various lines of cast-iron and concrete conduit, Imhoff tanks, sludge-drying beds, and an outfall sewer from the plant to the Delaware River, near which the plant will be located.

Items regarding the first and second set of bids received appeared in *Engineering News-Record* for Nov. 13 and Dec. 4, 1924, pp. 806 and 925. Mr. Sigretto was the low bidder on the first call, but his bid was declared to be unbalanced and all bids were rejected. On the second call the White company was the low bidder but counsel for Mr. Sigretto claimed that one item had been omitted entirely from the second White bid and that there were other irregularities in it.

No award of the contract will be made by the city council of Trenton until at least two weeks from the time the bids were received.

Abram Swan, Jr., is director of the Department of Streets and Public Improvements, and Alfred C. Gregory is engineer of sewers and water.

Study Started on Great Lakes Outlet Waterways

Final agreement between the governments of Canada and the United States has been reached in the matter of the Engineering Study of the St. Lawrence waterway. At the same time the United States is to make further study of a navigation outlet from the Great Lakes via the Hudson River. In reporting this action, Secretary Hoover has made the following statement:

"The final settlement of negotiations between the United States and Canada over the program for joint official investigation of the St. Lawrence waterway project marks a decided step in the progress toward determination of the facts and therefore the solution of the problem. The engineering work will start at once, Congress having appropriated $275,000 for the purpose and the Canadian government having made the necessary appropriations. A determination will be made of plans, cost amount of power developed, operating cost and all other engineering facts.

"Parallel with this investigation, there will also be an investigation which has been directed by Congress and covered by special appropriations, of the projected deep waterway from the Great Lakes to the Hudson River, to determine its feasibility, cost and operating expenses.

"These two investigations should be completed within approximately twelve months, and it will then be possible to finally determine national policies and to proceed with active steps in realization of the lakes to sea connection.

"Parallel with the engineering investigation, an exhaustive survey of the economic aspects of these outlets from the Great Lakes, the value of the development of electrical power from the St. Lawrence canal and other questions will be continued by the Department of Commerce."

The engineering work will be undertaken for both governments by a joint board of six engineers of whom the American representatives are: Brig. Gen. Edgar Jadwin, assistant chief of engineers; Col. Wm. Kelly, chief engineer, Federal Power Commission, and Lieut. Col. G. P. Pillsbury, all of the Corps of Engineers, U. S. Army. The Canadian members are: Duncan W. McLachlan, of the Department of Railways and Canals; Oliver P. LeFebvre, chief engineer of the Quebec Streams Commission, and Brig. Gen. Charles Hamilton Mitchell of Toronto. The Joint Engineering Board will at once commence work on the engineering surveys in accordance with their instructions.

The engineering investigation into the Great Lakes-Hudson River Waterway project will be conducted by Col. Herbert Deakyne, Col. Spencer Crosby, and Major P. S. Reinecke, all of the Corps of Engineers, U. S. A.

A report of the agreement between the two countries as to the scope of the current St. Lawrence Study will be available next week.

Failure of French Landing Dam

A complete report on the partial failure of the dam at French Landing, noted in *Engineering News-Record* April 16, 1925, p. 664, will be given in next week's issue.

Giant Power Scheme Killed

None of the bills introduced in the Pennsylvania Legislature in promotion of the so-called Giant power scheme, advocated by Governor Pinchot, have passed the Legislature nor is there any prospect of any of them passing, it is announced at Harrisburg.

A 15-Mile Water-Power Tunnel Contract Let in Scotland

A contract has been let for a 15-mile rock tunnel, 16 ft. in diameter, to be driven under Ben Nevis mountain, in Scotland, as part of the Lochaber hydro-electric project of the North British Aluminum Co. This tunnel will carry the water from two inland lakes to the power house on the coast at Fort William. Its cost is estimated at $8,750,000 while that of the entire project will be nearly $25,000,000, half of which is guaranteed by the government. The engineers are Balfour, Beatty & Co., Edinburgh, Scotland.

Congress Requires States to Aid in New Reclamation Projects

Appropriations made for four new reclamation projects by the Interior Department appropriation bill passed by the last Congress require that the states in which the projects are situated shall undertake the settlement and development of the projects. The projects in question are Kittitas (Wash.), Vale (Ore.), Sun River (Mont.) and Spanish Springs (Nev.). The Sun River appropriation, for example, provides that before expending it a contract shall be made between the United States and Montana.

"Whereby the state shall assume the duty and responsibility of promoting the development and settlement of the project after completion, securing, selecting and financing of settlers to enable the purchase of the required livestock, equipment, and supplies and the improvement of the lands to render them habitable and productive. The state shall provide the funds necessary for this purpose and shall conduct operations in a manner satisfactory to the Secretary of the Interior."

It is also provided in the law that the use of the appropriations shall be contingent on (1) the execution of contracts with irrigation districts providing for payment of charges by the district, and (2) execution of a contract restricting resale of lands until half the construction charges against such lands are paid.

In the appropriation for the Spanish Springs project, which is partly a relief for the present Newlands project and partly an addition thereto, the settlement-and-aid proviso is not mandatory but permissive, and applies to "the state of Nevada or local interests."

Bronx Parkway to Be Extended to Bear Mountain Bridge

The Bronx Parkway will eventually be extended from its present termination at the Kensico dam of Catskill Water Supply for New York City, to Bear Mountain Bridge, states Governor Smith in signing a bill abolishing the Bronx Parkway Commission. This extension will connect New York City, the Catskill and Croton water systems and Bear Mountain park with a continuous parkway, 45 miles long. When the Bronx Parkway Commission goes out of existence on Dec. 31, it will be succeeded by the municipal authorities of New York City and the county authorities of Westchester County.

Tornado Loss on Illinois Central

Damage sustained by the Illinois Central R.R. from the recent tornado in Illinois and Indiana is estimated to represent a loss of $33,000, as follows: Big Muddy Bridge, restoring to position, $1,700; Murphysboro, station, signals, fences and telegraph and telephone lines, $9,500; De Soto, Griffin and Parish, similar damages, $6,000, $4,500 and $2,000 respectively; Rend Siding, water station, $5,400; Texas Junction, section foreman's house, $400; miscellaneous damage, fences, clearing track and right-of-way, $4,000.

Random Lines

The Practice of Irrigation Engineering, A Manual for Beginners.

By John C. Cleghorn
B.Sc. in Min. E., C.E., S. I. (Sivil Ingineer)

Preparation—This is really the least important part of the subject so we hurry on.

Before embarking on practice one should have enough money to carry one two years, or better still have an independent income for life. (*Rule* 1).

Location—The question of location is very important. One should select a growing city or town in the arid belt surrounded by irrigable land and water. This requirement is not absolute, however, as some irrigation projects have been constructed where there was no water.

Outfit — The first few months of practice, an outfit will not be necessary. However, a few knickknacks such as one of the more popular makes of self-propelled vehicles and maybe a tape and hand level or a flossy transit with a good bubble and vertical circle with lots of fancy screws and gadgets on it will impress the onlooker. The use of the stadia method causes more wonder and admiration than all your diplomas and degrees.

Waiting for the Client—This is perhaps the most difficult part of practice until one gets used to it, after which it is the most pleasant. He should be of good cheer and spare no effort to appear in public. Spare time can be utilized in the lettering of a neat sign. The following is very effective:—Come IN and IRRIGATE. Of course one must be prepared to handle business. If the sign does not draw trade, paint a white mule under it.

Receiving the Client—The manner with which the client is received will determine the success or failure of the practitioner. My favorite method now is to hit the client on the head with a hammer and call the patrol wagon. This method is somewhat embarrassing to one's wife, so the usual way is to listen with glassy eye and poker face until the subject is revealed.

When the client has disclosed that he is promoting an irrigation district and contemplates making you the engineer provided your price is right—low enough he means—it is time to put a few questions and take the initiative. A good listener has the advantage up to a certain point. Beyond that it is false economy.

Insist on an immediate cash deposit to meet the cost of a preliminary investigation. The amount of one's estimates should be increased 100 to 200 per cent. (*Rule 2.*)

Handling the Project—Let us take the case of a small project. Assume that the engineer, in his eagerness to secure the work, has taken the job without any understanding as to immediate payment for his work. Or suppose he agrees to accept bonds on a percentage of cost. Suppose he has been able to assemble favorable data without having to perjure himself, and prepares plans and specifications which are approved by the land owners and work of organization of district is accomplished. It may be found at this point that the leading spirit or promoter has sold his land on the strength of its being in a district. There is nobody else in the district with gumption enough to take the leadership and the district sinks into a coma. The suggestion that the district make an assessment to cover the cost of engineering is met with a blank stare or a statement that you were to get your pay when the bonds were sold. But where are the bonds and what good would they be to you if you had them? So you have to get in and harass the defunct board of directors until they agree to proceed. Perhaps at this point you find that the fool lawyer who drew up the organization papers made a mistake and the district is null and void.

Under the law establishing irrigation districts, suppose you have to get the approval of the state engineer to the plans. The state engineer may be ex-officio secretary of the State Securities Board which certifies the bonds and guarantees the interest. It can be seen at once that the approval of the state engineer automatically makes him vouch for the feasibility of the project to the board when application for certification comes up. He is reluctant to commit himself. First he acknowledges the receipt of plans. Then you wait. Getting impatient, you write to enquire. He gets out the plans, glances over them and writes that he requires more information and further water records. You finish the information and work on the board of directors to help get more water records. They are indifferent and careless and even unreliable if they have to watch the recorders. This consumes two or three years.

In the meantime, in order to get everything ready to shoot when you get the approval of the state engineer, and perhaps at his suggestion, you proceed to get the district organization confirmed in the courts and hold your bond election and get the proceedings confirmed.

Make your bond issue twice as large as you think will be needed. (*Rule 3.*)

Suppose now that your plans have been sent back to you and revised so many times that your tracings are cut through, and your patience has been exhausted and you are about to commit mayhem upon the person of the state engineer. He concludes that the personal risk to his life is so great that he cannot stall you off any further, so he gives his conditional approval, provided that you make everything of concrete with gold trimmings. You recompute for the tenth time your estimates after making new tracings with the changes made and find that you are short of bonds.

You hope against despair and advertise your bonds and the contract. You get no bids with certified checks. One contractor makes a verbal bid for all the bonds and more. After several months another one comes forward and agrees to do the work for all the bonds. You take it up with the state engineer and he checks the bid against your estimate and finds that the contractor figures on getting the bonds at 82.75. After much haggling all get together and agree on 83. The engineering and legal fund is cut in half. By this time your morale is so low you would do the work for nothing.

The Construction — Nothing in the construction of a project should be beyond the engineer after he has all these years of experience. The time which would ordinarily be devoted to this lesson could be more profitably spent in reviewing *Rules 1, 2 and 3.* To them I would add:

Form at your earliest possible moment a connection with a reputable or disreputable bond house. The reason is obvious. (*Rule 4.*)

Conclusion — If the practitioner has reached this point he has long since lost the need of any manual.

Indiana Has $1,000,000 Highway Bridge Program

The state of Indiana will call for bids April 21 on approximately one million dollars worth of bridges, the letting of contracts on 53 structures to be done at a single time. The largest structure will be an 800-ft. bridge across the White River at a point known as Rogers Station on State Route No. 28 between Petersburg and Washington. The next largest is over Sugar Creek. It is a 300-ft. concrete and steel span between Rockville and Veedersburg.

The bridge pictured herewith is characteristic of the work being done by the bridge department of the Indiana Highway Department. It is a recently completed reinforced-concrete arch structure known as the Silver Creek Bridge.

New Orleans Zoning Ordinances Amended and Defined

What is known locally as a "key zoning ordinance" has been enacted by the council commission of New Orleans, La. Its preamble cites the state legislature act of 1918 authorizing cities to create residential zones and to exclude business therefrom, constitutional authorization to the same effect in 1921, and a decision of the State Supreme Court upholding both as valid exercises of the police power. The preamble then states that although the City Council of New Orleans believes in such zoning it at the same time realizes that "business and the growth thereof is essential to the life of the community" and it "does not desire to impose any unnecessary, arbitrary or unreasonable burdens on business." The ordinance then proceeds to affirm the earlier residence zoning ordinances with numerous exceptions under stated conditions.

Philadelphia Subway Contract Goes to Keystone Co.

The Supreme Court of the state of Pennsylvania reviewing the decision of the Court of Common Pleas in Philadelphia, which dismissed the taxpayers' suit to prevent award of the contract for a portion of the Broad St. subway to the Keystone State Construction Co., said: "The decree is affirmed at cost of appellant. Order now made so no time may be lost in proceeding with the public improvement. Formal opinion will be filed at a later date." As a result of this decision, the contract may go to the Keystone State Construction Co. or all bids may be rejected and new bids called.

Details of the suit were given in *Engineering News-Record*, March 26, p. 537, April 2, p. 573, and April 16, p. 667.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Spring Meeting, Cincinnati, Ohio, April 21-24, 1925.

AMERICAN WELDING SOCIETY, New York City; Annual Meeting, New York City, April 22-24, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Convention, Chicago, May 12-14, 1925.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago, Ill.; Annual Convention, Orlando, Fla., June 2-5, 1925.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa.; Annual Meeting, Atlantic City, N. J., June 22-26, 1925.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Meeting, Union College, Schenectady, N. Y., June 17-20, 1925.

The Western Society of Engineers' official nominations for officers (there is no opposition) are as follows: president, Homer E. Niesz; vice-presidents, F. E. Morrow, Major R. W. Putnam and John A. Garcia; treasurer, George W. Hand; trustee for three years, Frank D. Chase; members Washington Award Commission, E. T. Howson and R. F. Schuchardt.

The Illinois Association of Sanitary District Trustees will hold its second annual meeting, May 5 and 6 at Decatur, Ill. Some of the subjects treated are: "The Present Status of the Sanitary Districts in Illinois"; "River Pollution"; "Making Treatment Works Interesting to Visitors"; "The Decatur Sewage Plant and Testing Station" and "Operating Routine and Sanitary Work in the Tornado Area."

The Texas Section, American Society of Civil Engineers, will hold its spring meeting at College Station, Tex., April 30 and May 1. Papers to be presented at the meeting include one on pre-determining railway operating costs, effect of grade and road surface on operating cost of motor vehicles, description of various types of dams, and reports on the co-operative engineering school at Dallas, on the work of the State Board of Water Engineers and the state reclamation engineer, and a discussion on the engineer of Texas as affected by the policy of the State Highway Department.

The Mid-South Engineers' Convention, sponsored by the Engineers' Club of Memphis, Tenn., will be held May 7 and 8 at Memphis. The main subjects to be discussed relate to river, rail and highway transportation, highway construction, city planning and Muscle Shoals. Speakers scheduled include L. W. Baldwin, president of the Missouri Pacific R.R.; Paul H. Norcross, consulting engineer, Atlanta; Duff Abrams, Lewis Institute, Chicago; John F. Coleman, consulting engineer, New Orleans; W. W. DeBerard, Western Editor, *Engineering News-Record*, Chicago; Harlan Bartholomew, city planning engineer, St. Louis. The convention was planned by the Engineers' Club of Memphis to bring engineers of the Mid-South section together. The club is an active organization and has had a healthy growth in the past six years from 60 to 150 members. J. H. Haylow is president and Albert S. Fry, secretary-treasurer.

Personal Notes

H. N. RODENBAUGH, St. Augustine, Fla., formerly chief engineer and recently general manager of the Florida East Coast Railway Co., has been appointed vice-president of both the Florida East Coast Railway Co. and the Florida East Coast Car Ferry Co.

L. GLENN HALL, who for the past two years has been connected with the Boston City Planning Board, has been appointed park engineer for the public park system of Seattle, Wash. Mr. Hall recently graduate from the Harvard University School of Lanscape Architecture. During the recent campaign for the zoning bill of Boston he had charge of the publicity.

S. G. PORTER, superintendent of operations and maintenance, Southern Section, Department of Natural Resources, Canadian Pacific Ry., has been appointed assistant manager of the department with offices at Calgary, Alberta. Mr. Porter is a native of Kyle, Tex., and a graduate of Baylor University at Waco, Tex., and the Massachusetts Institute of Technology. After graduating from college he was for a time in the U. S. Reclamation Service and later chief engineer of the Arkansas Valley Sugar Beet and Irrigation Land Co. at Holly, Colo. In 1913 Mr. Porter went to Canada and was for a time assistant chief engineer and acting irrigation commissioner for the Dominion Government, later going to the Canadian Pacific Railway Co. to take the position which he is now vacating.

G. N. HOUSTON succeeds L. G. Porter as superintendent of operation and maintenance of the Lethbridge section of the Canadian Pacific Ry. irrigation system with headquarters at Lethbridge. Mr. Houston is a native of Connecticut and a graduate of Princeton University. After graduation he was for a time in engineering work in the East, later going to the Colorado College of Agriculture as associate professor of civil engineering and then to the University of Arizona as professor of civil engineering. Subsequently he was deputy state engineer of Colorado and then in private practice until, in 1913, he went to Canada and became principal field engineer of the C. P. R. irrigation system. During the war Mr. Houston returned to the United States for military services and upon going back to Canada was made assistant commissioner and later acting commissioner of irrigation for the Dominion Government and more recently a member of the Irrigation Council of the Provincial Government of Alberta.

Obituary

DAVID T. DAY, Washington, D. C., former head of the U. S. Geological Survey and for many years a leading authority on this country's mineral and petroleum deposits, died April 15 in Washington at the age of 66 years. Dr. Day entered the service of the Geological Survey in 1886, after graduating from Johns Hopkins University in 1881 and obtaining his doctorate degree there in 1884 and after two years' service as instructor in chemistry at the University of Maryland. In the Geological Survey he was chief of the Division of Mining and Mineral Resources from 1886 to 1914. From the latter date to 1920 he was consulting chemist to the Bureau of Mines. Throughout his life Dr. Day carried on important petroleum investigations which aided in the developments of the process of refining petroleum. He was an exhibitor at the centennial in Philadelphia in 1876 and was director in charge of petroleum exhibits at several world expositions. He was compiler of "Mineral Resources of the United States" and author of "Day's Handbook of the Petroleum Industry."

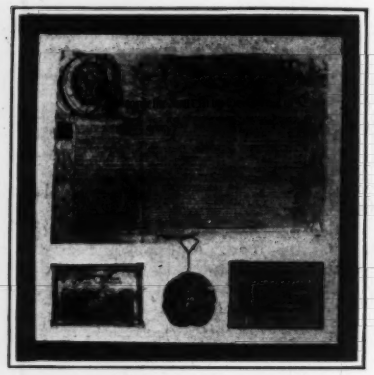
ARTHUR NICHOLS YOUNG, former city engineer of Wabash, Ind., died recently at his home in Indianapolis, Ind. Mr. Young was a graduate of Purdue University in the class of 1921. During the war he served with the Engineer Corps at Fort Sheridan and with the Coast Artillery at Fortress Monroe. After graduation, he was for a time assistant highway engineer of the Illinois State Highway Commission.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Smithsonian Institution Gets Aspdin Patent Facsimile

A facsimile of the patent granted Joseph Aspdin, of Leeds, in 1924, for the manufacture of portland cement, has been presented to the Smithsonian Institution by the Portland Cement Association. The presentation was made by George A. Ricker, district



engineer of the Portland Cement Association, Washington, late last month.

Included in the lower left-hand corner of the cut herewith is a photograph of the tablet given by the American manufacturers of portland cement to the city of Leeds, England, last year. The facsimile of the patent will be on view in the museum.

Largest Electric Sign Requires 50 Tons of Structural Steel

The Westinghouse Electric & Mfg. Co. at Philadelphia, Pa., has placed an order with the R. C. Maxwell Co., of Trenton, N. J., for an electric sign said to be the largest in the world. A steel structure 250 ft. long and 50 ft., high to carry the sign is now being constructed on the new Westinghouse building at 30th and Walnut Sts., Philadelphia, where the sign will be placed on the north and east end of the structure.

The contract really calls for two signs, the long sign on the north end of the building to be approximately 210 ft. long, reading "Westinghouse Electric" in two lines. Some idea of the size of the letters can be gained from the fact that the "W" starting Westinghouse is 27 ft. high by 36 ft. long, a capital letter about as long and twice as high as the average freight car. The east end sign is to be the Westinghouse trademark, 34 ft. in diameter, completed by a series of flashes.

More than 50 tons of steel are being put into the frame to carry the sign. About 5,000 Westinghouse daylight lamps will be used to illuminate the sign from dusk to dawn every day.

Business Notes

HARNISCHFEGER CORPORATION, Milwaukee, Wis. (formerly Pawling & Harnischfeger Co.) announces the location of a new branch office at 431 First National Bank Bldg., Birmingham, Ala. James Van Buskirk has been transferred from the Detroit office of the company to take charge. H. E. Mensch succeeds Mr. Van Buskirk in the Detroit office.

H. W. CHOWN, until recently with the Holt Manufacturing Co., Peoria, Ill., where his work consisted of the application of Holt tractors to contracting and industrial work, has been appointed sales manager of Roy C. Whayne Supply Co., Louisville, Ky., manufacturer and distributor of equipment.

LINDSEY E. THOMPSON, formerly sales manager of the National Sewer Pipe Co., Webster City, Iowa, has become field engineer of the Illinois Paving Brick Manufacturers Association with headquarters in Webster City.

ALAMO IRON WORKS, San Antonio, Tex., is contemplating plant improvements which will include a steel, fireproof foundry providing about 10,000 sq.ft. of floor space, a new steel structural shop and a steel fabricating plant for reinforcing.

C. W. ROSS, formerly with the Beaumont Co., is now manager of the Philadelphia office of C. O. Bartlett & Snow Co., Cleveland, Ohio, designer and builder of material handling and processing equipment.

Equipment and Materials

Six-Wheel Unit for Heavy-Duty Motor Trucks

To convert a four-wheel truck into a six wheeler, Six Wheels, Inc., of Los Angeles, Calif., has manufactured a unit consisting of an axle and two wheels, together with springs, rocker arms and castings necessary to attach it to any heavy-duty motor truck,

thereby gaining increased payload in states where the legal weight limit is specified in terms of weight on any one axle or wheels, and materially reducing the shock impact to road and truck.

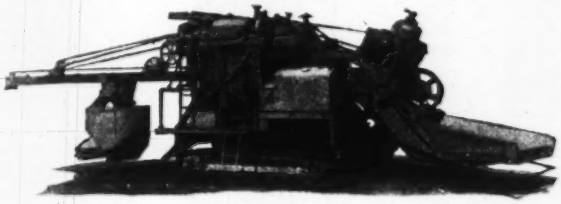
By a device that connects them with the front wheels, the extra wheels of the Maxi six-wheel unit steer in proportion to the front ones, thereby keeping tire expense down to a minimum.

This attachment is so devised that one-third of all the weight not carried on the front axle is carried on the unit. The rocker arm which connects the rear spring with the intermediate spring is so designed that it has a wide differential, thereby keeping the load distribution on each axle constant.

One of the features is the added frame support derived from the use of this attachment provided by the semi-elliptical spring of the six-wheel unit. Ninety or more 5-ton Maxi unit equipped trucks have been operating in southern California for a year or more with a gross weight of truck and load of 34,000 lb. (legal weight on six wheels in California) without one case of frame sag being reported.

Paving Mixer Has Folding Top

The folding top, first developed on the Rex paver about two years ago, is now standard equipment on all its machines, according to announcement by the Chain Belt Co., Milwaukee, manufacturer of Rex mixers and pavers.



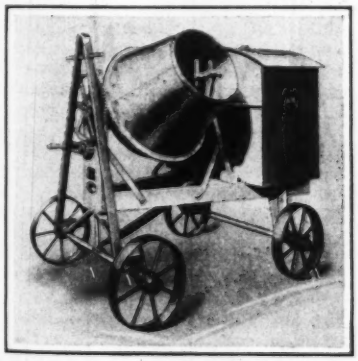
With the folding top, when it is necessary to pass under low obstructions, instead of removing the top frame entirely or making a long detour, it is necessary only to fold back the top, which is hinged at the front end and is power operated. When lowered, the overall height of the paver is only 11 ft., which permits the machine to pass under all ordinary obstructions such as low subways, elevated tracks, street car wires, and bridges or viaducts.

While the folding top has many new advantages, it also retains all of the advantages of the old rigid design, including high mounting of the water tank, so necessary for a dependable water supply. The tank is mounted on the top frame and folds back with it, as shown in the accompanying illustrations. The machine is not dismantled when shipped by rail. When it arrives on the job, it is necessary only to fold the top back into place and the paver is ready for operation.

Another improvement in the 1925 model is greater speed in discharging. The mixer can now be discharged in 8 sec. The blades and buckets have been made larger, increasing their shoveling capacity, so that faster charging and discharging is possible. When the operations are synchronized, charging and discharging can be done in 9 sec., the manufacturer claims.

New 3½-S Tilting Mixer

The Ransome Concrete Machinery Co., Dunellen, N. J., is offering a 3½-S tilting mixer, which differs from other machines of this type in a number of



particulars, chief of which is the use of Timken tapered roller bearings on the spindle and the absence of castings in the truck assembly. Two types of mounting are available: the trailer type, in which the mixer is mounted on two rubber tired wheels with coil springs between the axle and the frame, and the truck type, where the mixer is mounted on 19-in. steel wheels.

Sturdy construction throughout features this mixer. The main frame is made of 4-in. channels, axles are of cold-rolled steel, the lower half of the drum is a high-grade casting and the upper section is of steel plate reinforced at the lip. The double-slat blades give good mixing action and with the anti-balling blades mounted in the base of the drum and the generous water clearances materially accelerate the rate of mixing.

The drum can be charged or discharged from either side. While in charging position it is of the usual height, but it can easily be discharged into large mortar barrows. The drum can be easily tilted with one hand and locks in any desired position. The drive from the engine to the countershaft is through sprockets and pintle chain, both being protected against stones or gravel by the engine housing.

New Mortar Material for Inside and Outside Walls

A new mortar material for covering the exterior and interior surfaces of walls is soon to be put on the market by the Louisville Cement Co., Louisville, Ky. It is called Walsment and is a plastic combination of cements. Four or five years experimenting has led the company to make the claim that it is practically impervious to water and that dampness does not cause it to scale or disintegrate.

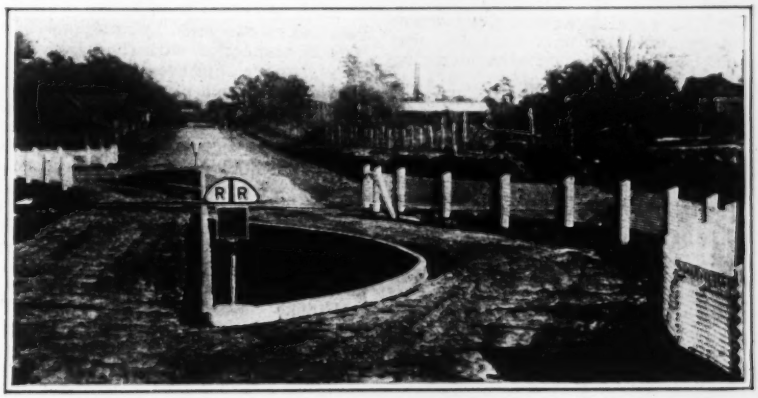
When applied to metal lath on either the interior or the exterior of buildings, it forms a reinforced-concrete covering; when applied to interior walls, the surface is so hard that it is not easily scarred. When employed either in stucco or interior plaster, Walsment lends itself to any kind of finish desired.

When mixed on the job with the specified amount of sand and water, Walsment is ready to apply. It may be applied to wood lath, metal lath, brick, tile or concrete. For interior work it may be sand finished, white coated, trowelled smooth for papering, or given a natural finish. On exterior work it can be applied in the same manner as portland cement stucco. Its natural color is a light tan.

It is also claimed that, since it does not absorb moisture from the air, it may be stored two years or longer without deterioration. It is shipped in paper bags of 80 lb. each and in cloth sacks of 100 lb. each.

Safety Island and Wire Fence For Grade Crossings

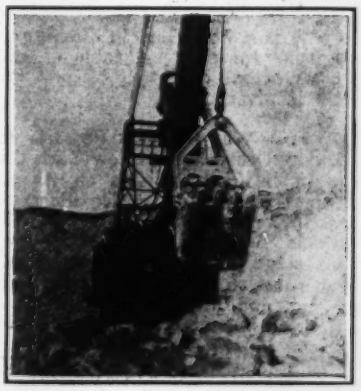
The Page Steel & Wire Co., Chicago, has furnished a heavy resilient wire-link fence as part of a grade-crossing safety device developed by engineers of the Florida State Road Department and installed at a crossing of the Atlanta & St. Andrews Bay R.R. at Cottondale, Fla. There is a half-circle



island at the center of the road on either side of the track, with its diameter along the center line of the roadway and with its arc offering obstruction to traffic in either direction. The Page Hi-Way guard at the outside of the road keeps the car from crashing onto the tracks in case the driver cannot slow up in time to make the bend.

Six-Yard Electric Shovel Used in Coal Mine Stripping

One of the largest revolving electric shovels yet built is in operation in the Crystal Ridge basin of the Mammoth



coal bed, near Hazleton, Pa., owned by the Cranberry Creek Coal Co. This shovel was made by the Bucyrus Co., South Milwaukee, Wis., and is used in stripping a coal mine formerly worked by underground methods and abandoned for many years as being worked out. This stripping area comprises a section 2,700 ft. long and about 500 ft. wide. The maximum depth to the top of the coal is approximately 165 ft., and the minimum thickness of cover is 95 ft. The total volume of overburden to be removed is 4,000,000 cu.yd. About 90 per cent of this consists of hard sand, rock and fine conglomerate and the remainder of surface soil, clay and drift. It is estimated that it will take five years to remove the overburden and extract the coal.

The more important dimensions of the shovel are: Capacity of dipper 6 cu.yd. (struck measure) and 7½ cu.yd. (heaped measure); length of boom (lower end to center of hoisting sheave), 85 ft.; length of dipper handle, 58 ft.; maximum height of dump above rail (boom at 45 deg.), 65 ft.; approximate working weight, 760,000 lb.; dumping radius at maximum dumping height, 94½ ft.; maximum dumping radius (dumping height 48 ft.), 97½ ft.; radius of cut (at 40 deg. elevation of lip), 101½ ft.; radius of cut at bottom of pit, 59 ft.; radius of rear end of revolving frame from pivotal center, 33 ft. 4 in.; overall width and length of revolving frame, 20 ft. 1 in. x 49 ft. 8 in.; height of A-frame above top of rail, 50 ft. 2½ in.; size of lower frame (center to center of main girders), 30 x 30 ft.; diameter of roller circle, 30 ft.; number of rollers, 84; diameter of rollers, 10½ in.; pitch diameter of rack gear on lower frame, approximately 26 ft. 9 in.

Publications from the Construction Industry

Use of Compressed Air—SULLIVAN MACHINERY CO., Chicago, in a 16-p. booklet, emphasizes the economy in the use of compressed air by the road and street contractor, the highway engineer, public utility companies, street railways, and others having outdoor construction or repair work.

Ditch Digger — BARBER GREENE CO., Aurora, Ill., has issued a new 20-p. illustrated catalog showing the advantages of its ditcher in cutting service ditches for water and sewer pipes, in digging post holes and in ditching for telephone conduits. A table of costs for its actual operation by one company is given.

Pumps—WORTHINGTON PUMP & MACHINERY CORPORATION, New York City, has published a bulletin on its centrifugal pumps. In it are illustrated and described single-stage pumps suitable for low or medium heads, multi-stage pumps for higher heads, a double-suction turbine pump for boiler feeding, and large pumps for use in irrigation and drainage and in waterworks.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bank Debits vs. Clearings as Index of General Business Conditions

Latter Involve Duplication and Do Not Include Checks Cashed at Banks on Which They Are Drawn

BY GEO. B. ROBERTS

Manager, Reports Department, Federal Reserve Bank of New York

For many years business men have been accustomed to look upon bank clearings as one of the most trustworthy measures of changes in business activity. Approximately 90 per cent of all payments for goods and services are made by check and the figures therefore have been regarded as reflecting all forms of business better than other commonly known indexes such as railway traffic, employment, pig iron production, and the like. Many concerns, by studying clearings in connection with their own businesses, have discovered relationships which assist them materially in shaping their manufacturing and merchandising policies.

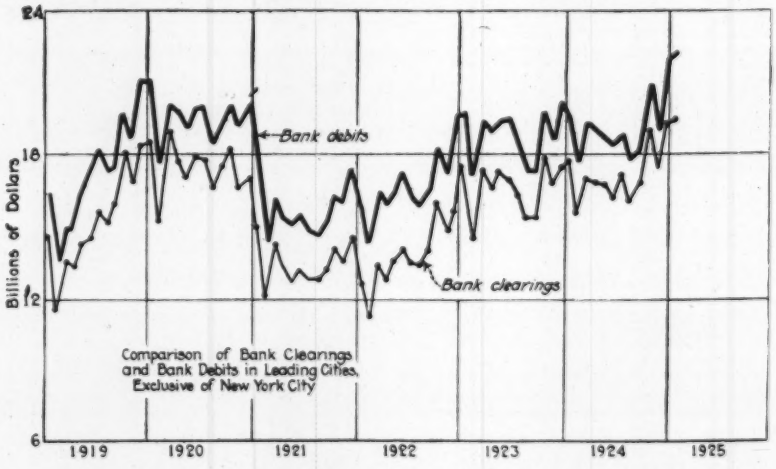
Within recent years, however, another and more accurate index of business payments has been made available through the collection of figures of debits to individual accounts by the Federal Reserve Banks. These figures, while rather formidably named, are nothing more than the charges reported by banks against customers' deposits as the result of checks or other payments. They are thus quite different from clearings, which are the records made at clearing houses of the checks that pass through them for collection. While these differences are generally recognized, there is undoubtedly much uncertainty in the minds of business men as to wherein the debits figures are superior.

In considering these two types of figures it should first be said that for representing the general swings of business over a period of years there is not much to choose between them. The accompanying diagram presenting a comparison of debits and clearings for leading cities, exclusive of New York, since 1919, shows that the fluctuations in both have been very similar. In fact, if clearings are raised by about 14 per cent, they will fit very closely to the debits line, and the same correspondence exists in New York City when clearings are raised 5 per cent. Hence, for historical purposes and in order to secure a continuous record of business payments prior to 1918, when the collection of debits figures was begun, it seems entirely practicable to substitute in these earlier years raised clearings for debits. Some of the studies published by the Federal Reserve Bank of New York show debits hitched to clearings in this way, and the whole presents a striking picture of the ups and downs of business over a period of the past fifty years.

For current records, however, and particularly for figures of individual cities, the use of debits is greatly to be preferred over clearings. This is for two reasons.

In the first place, clearings include only checks sent through clearing houses, and therefore fail entirely to take account of the many checks which are presented for payment at the banks on which they are drawn. Debits, on the other hand, include all check payments, whether of checks presented through the clearing house or not.

In the second place, clearings involve duplication, as checks frequently pass through several clearing houses for collection, and in so doing are counted each time in the total. Debits, however, are reported only when the checks are finally collected.



Of these two shortcomings on the part of clearings, the first is the more serious, and its effect is to render particularly misleading the figures for individual cities. The following table comparing clearings and debits in 1924 for different cities in the Second Federal Reserve District reflects the wide discrepancies that exist between two sets of figures, particularly in the smaller cities where a relatively large proportion of the checks is cashed at the banks on which they are drawn. As a measure of business volume it is obvious from these figures that clearings are quite inadequate, and in some cities where consolidations are reducing the number of banks the clearings may even give the impression of declining business. Debits, on the other hand, are unaffected by conditions of this sort, and would be the same regardless of whether there was only one bank or many. To a large extent the collection of debits has been the result of agitation on the part of city commercial organizations against such misrepresentation in the clearings as is shown in the following table:

(000,000 omitted)

	Bank Clearings	Bank Debits	Ratio of Clearings to Debits
New York City.	$249,868	$263,531	95
Buffalo	2,310	3,630	64
Syracuse	262	802	33
Rochester	599	1,856	32
Binghamton ..	53	235	23
Albany	296	1,410	21

For business men who desire to follow debits closely, figures are now available each week for 250 clearing centers throughout the country, or a considerably larger number than is included in any of the tabulations of bank clearings. While for some of the recently added smaller centers totals can be had only for recent years, one can obtain a continuous record all the way back to January, 1919, for 141 of the larger centers whose figures amount to more than 90 per cent of the aggregate. In a number of important cities, the publication of clearings figures has been discontinued altogether and bank debits substituted.

Under the present practice debits are collected for the week ended Wednesday night and are available for publication in the press on the following Sunday. Except in the cities where Federal Reserve Banks are located, and which tabulate the figures, the debits are collected through the medium of the local clearing houses, which wire them to their respective Reserve Banks, where they are in turn forwarded by telegraph to the Federal Reserve Board at Washington. Upon the basis of these returns, the Board prepares the press statement on the figures for the entire country. While the figures are not fully reproduced in the press, owing to the limitations of space, a number of the leading papers carry the totals by Federal Reserve districts. In case any individual or concern, however, desires to obtain at the earliest possible moment the total figures for separate cities, they may, upon application, be placed upon the mailing list to receive the press statement direct from the Federal Reserve Board as soon as it is issued. In addition to the weekly statement, the Board publishes each month in the Federal Reserve Bulletin tables showing weekly debits by Federal Reserve districts, and by 35 leading cities where Federal Reserve Banks or their branches are located.

As the purpose is to represent only actual business transactions, the figures exclude all debits to bank accounts, cashier and treasurer checks issued by a bank, debits in settlement of clearing house balances, charges to expense and miscellaneous accounts, and corrections and similar charges. The figures, however, do include all debits to the accounts of individuals, firms, corporations and the United States Government, including debits against savings accounts, payments from trust accounts, and of certificates of deposit, and cashier and treasurer checks issued by firms or corporations.

Summarizing briefly, then, the relative advantages of debits and clearings, it may be said that:

(1) Bank clearings present a fairly adequate picture of the swings of business, particularly over an extended period of time.

(2) They are, however, subject to inaccuracies which make them less desirable for current comparisons where greater accuracy is desired. Because of their failure to take account of checks deposited on banks directly, they are likely to be particularly misleading for comparisons in the cases of individual cities.

(3) Figures of debits are now available for a larger number of cities than is the case with clearings, and a continuous record covering a large proportion of the total is available back to 1918.

(4) The weekly data are readily available to business men, either through the Federal Reserve Bulletin, which is the regular monthly publication of the Federal Reserve Board at Washington, or by means of mimeographed press statements, which will be mailed upon request directly from the Board each week to the person or concern interested.

Business Briefs

Call money firm at 3½ per cent, Monday, April 20; year ago, 4 per cent.

Time loans: short terms, 3½@4 per cent; longer periods, 4 per cent.

Commercial paper: best names, 4 per cent; other names, 4¼ per cent.

Foreign exchange (Demand):

	Par	This Week	Last Week	Year Ago
Sterling..	$4.8665	$4.78 7/8	$4.78⅛	$4.37⅛
Franc....	.193	.0521½	.0517½	.0533⅓
Lira.....	.193	.0409½	.0410	.0444⅓
Mark.....	.238	.238	.238	
Florin....	.402	.3988	.399	.3724
Peseta...	.193	.1429	.1424	.1416
Krona....	.268	.2695	.2694	.2637

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks.

Minimum costs observed are: $15,000 for waterworks and excavations, $25,000 for other public works, $40,000 for industrial and $150,000 for commercial buildings.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Apr. 23, 1925	**$22,676,000**	**$31,108,000**	**$53,784,000**
Apr. 16, 1925	10,778,000	21,051,000	31,829,000
Apr. 24, 1924	22,575,000	12,153,000	34,728,000
Heaviest Week Last Year			
May 8, 1924	26,370,000	38,829,000	65,199,000
This Year			
Apr. 2, 1925	43,603,000	27,633,000	71,236,000
Jan. 1 to Date			
1925	278,472,000	399,896,000	678,368,000
1924	276,679,000	363,565,000	640,244,000

Unit Costs Shown on Western Paving Jobs

Costs of operations and materials on a boulevard paving job in St. Charles, Ill., awarded to Hans Jensen of St. Charles, compare as follows:

Work and Materials	Quantities	Unit Price
Grading	9,229 cu.yd.	$0.70
Paving, 8 in.	15,489 sq.yd.	2.49
Combined curb and gutter	11,492 lin.ft.	.75
Expansion joints, 8½ in.	5,995 lin.ft.	.20
Pine headers, 3 x 12 in.	406 lin.ft.	.40
Removing curb	925 lin.ft.	.15
Manholes	1	40.00
Combination manholes and catch basins with c.b. covers	4	50.00
Combination manholes and catchbasins with m.h. covers	7	50.00
Storm water inlets	26	29.00
Manholes adjusted	15	5.00
Vitrified tile pipe, 15 in.	1,051 lin.ft.	1.50
Vitrified tile pipe, 12 in.	1,118 lin.ft.	1.40
Vitrified tile pipe, 10 in.	73 lin.ft.	1.00
Vitrified tile pipe, 8 in.	866 lin.ft.	1.00

Unit costs on vibrolithic concrete pavements (7-in.) for West Chicago, Ill., awarded to the Gund-Graham Co., are arranged as follows:

Work and Materials	Quantities	Unit Price
Excavation	4,234 cu.yd.	$0.40
Concrete pavement	9,209 sq.yd.	2.68
Curb and gutter 12 in.	7,173 lin.ft.	.50
Pine headers 3 x 12 in.	100 lin.ft.	.40
Expansion joint, 7½ in.	2,974 lin.ft.	.14
Manholes and c.b. adjusted	24	4.00
Combination manholes and catch basins	1	50.00
Manholes	1	45.00
Storm water inlets	8	30.00
Storm drain, 10 in.	504 lin.ft.	1.00
Storm drain connections, 8 in.	242 lin.ft.	.80

A contract awarded to the P. J. Anderson Constr. Co., Ogden, Utah, for grading and draining 1.37-mi. and gravel surfacing 4.46-mi. of the Old Oregon Trail between Alexander and Soda Springs in Caribou Co., shows the following unit costs:

Work and Material	Quantities	Price	Amounts
Excavation, solid rock	20 cu.yd.	$2.00	$40.00
Excavation, loose rock	50 cu.yd.	1.00	50.00
Excavation, earth	3,334 cu.yd.	.35	1,166.90
Overhaul	2,307 sta.yd.	.04	92.28
Excavation, earth, strip, pits	100 cu.yd.	.30	30.00
Surfacing crushed gravel	10,459 cu.yd.	1.90	19,872.10
Class "B" concrete	3.51 cu.yd.	20.00	70.20
18 in. G.I.P. culverts, H. & P.	56 lin.ft.	.75	42.00
24 in. G.I.P. culverts, H. & P.	28 lin.ft.	1.00	28.00
Total			$21,391.48

Weekly Construction Market

THAT a strong undercurrent is running through the main channels of business is evident from the following: (1) Heavy loadings of revenue freight, over 900,000 cars per week since the first week in March; (2) great volume of bank debits or check payments; (3) numerous favorable reports on corporate earnings for the first quarter of 1925; (4) capacity operations in the automotive industry; (5) record March exports.

These important factors are offset to a degree, by reports of slowing down in iron and steel, textiles, coal, chemicals and other industries.

Price declines are also developing in several directions. With the possible exception of tin and zinc, the non-ferrous metals market is declining. The price structure of ferrous products is weaker in all lines from semi-finished steel clear back to the iron ore.

Much of the activity alluded to in the first paragraph concerns materials already bought and now in process of delivery or assimilation. If more active buying does not start by the fourth quarter of the current year, the present depression at the mills will be reflected in general business conditions. Agriculture and construction are the two strongest bidders for labor in the present market. There is some slight gain in building materials manufacturing.

The Northwest fir lumber mills are holding the small gains made in new orders and domestic cargo business is increasing. Southern pine timbers and railroad material are going well.

The principal price declines of the week occurred in c.-i. pipe, brick, lime and lumber; there were no advances of note. Linseed oil continues to fluctuate.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.90	$4.15	$3.10	$3.35	$3.07½	$3.30	$3.35	$4.25
Structural rivets, 100 lb.	4.50	4.45	4.75	3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	3.38	3.00	3.25	3.87½	3.35	3.25	2.30
Steel pipe, black, 3½ to 6 in. lap, discount	48%	53.2%	43%	56½%	54.25%	36%	+40.6@52.1%	50%	59.49
Cast-iron pipe, 6 in. and over, ton	52.60@53.60	—55.00	56.00	46.70@48.20	—53.00	62.00	55.00	55.00	60.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.30	2.05	2.20	2.42	2.84	2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.75	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75	1.75	2.50	2.15	3.00	1.90
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—58.00	35.00	56.00	29.00@39.00	39.75	34.75	27.00	—23.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	—18.00	—18.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@2.75	1.45	1.85	1.21	1.35	2.70	1.60	2.80	9.50
Common brick, delivered, 1,000	17.00	10.50	—11.60	12.00	13.50@13.60	12.00	15.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.0808	.0941	.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.0808	.0941	.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	1.09	—1.15	—1.28	+1.26	1.18	+1.30	—1.20	1.12	1.11
Common Labor									
Common labor, union, hour	.75	.30	.....	.87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.75	.50@.55	.35@.50	.50	.50	.20@.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 50c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.60 for Sheboygan. Common labor not organized.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 2, the next on May 7.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3½-in., $59.49.

Gain in Less-Than-Carlot Freight Shows Small Quantity Buying

Revenue freight loadings are heavier than a year ago to date, or in fact, than for the corresponding period in any year since 1921.

Loadings of materials received from shippers in less-than-carload quantities form an increasingly higher percentage of the weekly loadings of all classes of freight, compared with last year.

This does not indicate any decrease in volume of business but does reveal the development of a tendency among buyers to order smaller quantities at shorter intervals.

Lack of pressure at mills and availability of freight cars probably account for the present leisurely attitude of the purchasing public.